THE WORLD OF WINGS AND THINGS

SIR ALLIOTT VERDON-ROE, O.B.E.

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Preface by

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PREFACE

By Major OLIVER STEWART, M.C., A.F.C.

EXECRATION, probation, canonization; these are the three stages in the progress of the pioneer. Sir Alliott Verdon-Roe, inasmuch as he worked in England, where opposition to new things (expressed in the national proverb: 'What is new is not true') is bitterest and most implacable, had more than his share of the first stage when he was building and flying his early aeroplanes and was mercilessly obstructed in all his experiments. But by dint of faith and a truly heroic determination, he conquered, his work was accepted, and its merit recognized.

No spectacle is more stirring than that of man alone, inspired by an idea, struggling against odds, pitting himself against a hostile world. It is impossible not to experience exhilaration as we watch him in this book during those early days. We see him fighting round after round against the forces of tyranny and intolerance, going down again and again, but still finding strength to rise and fight on, and, in the end, to win.

To me one of the most remarkable things about the story Sir Alliott unfolds in these pages, is the absence of resentment at the way he was treated when he was building and flying his early aeroplanes. The obfuscated officials and litigious local authorities who hounded him about and did everything they could to put obstacles in his way, appear not—as they would

have seemed to me—as monsters of malicious ignorance, but as comedians. The astounding 'business' with the small shed at Brooklands, when 'A. V.' was incessantly being ordered to move it from one part of the ground to another, the desperate anxiety of the different local authorities to ensure that so undignified a process as aviation should not occur in their districts, the portentous utterance of a distinguished newspaper upon the inherent impossibility of heavier-than-air flight; these take on a richly comic aspect.

Behind this good humour, however, one traces the steel determination of one who believes in what he is doing. 'A. V.' countered gross obstruction with delicate ingenuity. When forbidden to sleep in his hangar, his stage 'good night' to the gate-keeper, prior to the surreptitious return to shed and bed over the fence; his secret piece of detachable spiked railing which enabled his machine to be moved to the flying area: these are instances of power of invention and circumvention of a high order. And sometimes, when I read these pages, I wonder if the blundering, blustering officials and authorities are not more deserving of sympathy than 'A. V.' They were no match for him and though it must be confessed that they hampered and retarded his experiments, they never even looked as if they would deflect him from his purpose.

'A. V.' built, flew, crashed, and rebuilt his little machine with persistence. The crashes were anticipated even to the extent of a helper following the machine on a bicycle carrying a fire-extinguisher. If ever man proved that faith is invincible, it was 'A. V.' Undeterred by failure, unruffled by interference, undismayed by design and constructional difficulties, he developed his machine.

His first flight was made on 8 June 1908 at Brooklands, and the distance covered was about 150 feet.

It was the first flight made in England. But his position as Britain's greatest aeronautical pioneer does not rest on this. He pioneered not only flight itself; but also the tractor biplane, the triplane, and the closed cabin machine. His 9 h.p. 1909 triplane achieved flight with less power than any other machine until 1923. He built what must still be looked upon as the best aeroplane ever produced, the 'Avro' two-seater training machine which was manufactured in thousands during the Great War, and which set up a record in its length of useful life.

The War proved the worth of 'A. V.'s' work to the populace. But the use of the aeroplane for war he held, and still holds, in detestation. He says in these pages that if the aeroplane is to continue being developed primarily as a weapon of war, it might have been as well if all those early experiments had ended in nothing. But at the same time he expresses the belief that eventually the aeroplane will be turned from destructive to constructive purposes and be used for the benefit and not the downfall of mankind. The War of 1914 altered the scale of 'A. V.'s' work from the smallest to the largest. It was a big change from the time when he cycled from Wandsworth carrying on his shoulder some long pieces of timber which were to fulfil all his wood requirements, to the time when his company was buying timber by the shipload.

Although the War established 'A. V.' as not only a great pioneer, but also as a great manufacturer, he was still to hear one more echo of his early experiences. In June 1928, twenty years after he had made his first flight, an august committee was set up which inquired into the matter of first flights in England, and decided that 'A. V.'s' was not the first 'free' flight as the committee understood that term, but that the first 'free' flight was made some time afterwards. Actually it is almost immaterial whether the pro-

nouncement of this committee is heeded or not, for, as I have mentioned, 'A. V.'s' reputation does not rest on one thing, but many things. If the committee's finding is accepted, therefore, and we say that 'A. V.' was the first man to make a flight in England, but that somebody else was the first to make a 'free flight' the place he holds in aeronautical history is unaltered. He is recognized as England's great aviation pioneer.

His was the mind that looked farthest ahead and that succeeded in wedding theory and practice. It may, perhaps, be thought curious that a committee should try to diminish in any way the greatness of his achievements. It might have been imagined that in twenty years he would have been forgiven for being a pioneer, but the committee's finding may be said to have ended the period during which recognition was withheld. From that time until now, appreciation of the extent of 'A. V.'s' contribution to British aviation spread swiftly. Committees can no more harm him to-day than could the bailiff who was set upon his track by a disapproving local authority in 1909.

For those who are concerned in any way with aviation, this volume provides some important information about the structural methods and control devices of the early 'Avro' machines. These facts have not been authoritatively discussed before and they throw much light on subsequent developments. The method of control by varying the angle of the main plane, for instance, was re-introduced as a great novelty not long ago after having been used in the 'Avros.'

Every aspect of 'A. V.'s' work as it is revealed in these pages shows far-sightedness and intellectual daring. It is for that reason as much as any other that attention should be paid to the chapters in which he speaks of the future. In these he makes some very remarkable suggestions and speaks of advances which

seem, at the present time, almost fantastic. His statement about methods of propulsion through the air without the use of the ordinary air-screw or by a method of flapping wings, for instance, seems to be so far removed from present realization as to constitute an imaginative dream rather than a practical possibility. Yet it is worth recalling that it was precisely as an unrealizable dream that flight was regarded by many people at the time when 'A. V.' knew it to be practical and had visualized the method of achieving it. It behoves us to beware, therefore, how we look upon these other proposals. It behoves us to take special pains not to condemn them because they are new.

It is the same with the currency proposals which 'A. V.' is now advancing. Currency theory is a thing of which I possess no knowledge whatsoever; but I look back at the record of 'A. V.' and ask myself whether, in the face of the proofs of far-sightedness which he has given not once, but scores of times, and of the evidence we have of his essentially practical outlook, it would be wise to neglect his suggestions. For the lesson which appears in these pages is concerned as much with the discomfiture of those who refuse to look ahead and refuse to visualize changes, as with the triumph of one who can correctly foresee those changes.

It is fitting that in the Imperial Institute at South Kensington a statue of Sir Alliott Verdon-Roe should be placed, and that he should be the only living aviator and that word with its faint flavour of the pioneering period is appropriate—thus honoured.

His aeronautical work extends from 1906, when he was experimenting with models and devoting all his time to aviation, through the historical 1908 and 1909 full scale flights, the 1910 tractor biplane and the 1912 closed cabin monoplane, through the War period, to the 'Avro Baby' of 1919, prototype of the light touring

machine. Though he is now no longer actively connected with the company which bears his name, the impetus he gave it remains to this day.

If one looks back at the big family of 'Avro' aeroplanes one sees clearly defined a likeness and a co-ordinating influence. There is about them all the stamp of original thought and enterprise. Even their flying manners seemed to be similar. Fortunately photographs are available of the original 9 h.p. triplane in flight and they make a fascinating study. The undercarriage alone, in view of the recent developments of this component, is worthy of special note. So are the tail wheel, the tractor air-screw and the covered-in fuselage. It is astonishing that, in the year 1909, a flying machine so strongly indicative of what might be called the War and immediate post-War aircraft should have appeared.

Although 'A. V.' chose aviation and turned the full resources of his brain to that, his story has much more than a purely aeronautical significance. It is, as I hinted at the beginning of this Preface, the story of all great pioneers, perhaps heightened in tone through the intense topicality of aviation, but essentially similar. The period of execration was lived through and lived down with undiminished faith and unshaken determination. The period of probation was smoother going, for then the country was at war and found itself urgently in need of the skill and experience of its aviation pioneers so that it could no longer afford to obstruct them and jeer at them. Even then the canonization, as I have called it, was long delayed and a few people still refused to accept 'A. V.' as one worthy of the highest honours.

I look upon an official dinner given on the twentieth anniversary of the first flight in 1908 as the beginning of full public recognition of 'A. V.'s' unique standing in the world of aviation. This dinner was given by

the Royal Aeronautical Society, the Royal Aero Club, the Air League of the British Empire, and the Society of British Aircraft Constructors. Sir Charles Wakefield, as he then was, presided and the Duke of York, our present King, was there.

It is true—and perhaps this may seem a comment upon one of the less pleasant sides of the English character—that recognition of this air pioneer was long delayed and that he had to fight the assembled forces of prejudice and intolerance to obtain it. But when he finally did attain it the recognition was generous. And it is precisely because to-day the British people have learnt to appreciate the genius of Sir Alliott Verdon-Roe that this volume is of value. It gives in the simple, faintly humorous sincere manner which is characteristic of its author the story of one of the most remarkable careers in the history of aviation.

OLIVER STEWART.

LONDON, *April 1939.*

ERRATUM

Page 144, line 13, *for* "Shortly after the War" *read* "During the War, early in 1918".

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FOREWORD

ROBERT BURNS in two well-known lines wishes for that 'giftie' which might give us the power of seeing ourselves as others see us.

For my own part I would like to emphasize that in this book of reminiscences I have been more concerned with the story of my experiments and experiences in aviation and my views of the future rather than in probing into the foibles of my personal life which is so often the object of those people who write auto-biographies.

Half of this volume is concerned with giving as accurate an account as possible of my early experiments with the reasons on which they were based. Although this period is only thirty odd years back yet it has already become an historical era.

I have few 'confessions' to make, and I hope that nothing I have written will, in any way, offer hurt to anyone's feelings. Where I have offered criticisms it has been with good intent.

In the preparation of this book, and especially with the desire to be accurate I have had occasion to consult several sources of information. For this assistance and material I wish to make acknowledgment. I have borrowed freely from articles which I have written at various times in *Popular Flying*, *Air*, and *War in the Air*. I have also made extensive use of articles dealing with 'Avro' machines which have appeared in the pages of *Flight* and *The Aeroplane*. Both these papers have also kindly assisted me by the loan of certain of the photos

which appear in these pages. I have chosen the photos rather for their historical interest than according to any standard of technical or artistic merit.

I have had valuable help in confirming dates and other historical facts from Major C. C. Turner's book, *The Old Flying Days*, which has proved an invaluable record.

I am exceedingly grateful to Major Oliver Stewart for his kindness in writing a Preface to my book, and I hope my future activities will live up to his expectations. I am also greatly indebted to the Earl of Cardigan and Mr. Smith-Barry for their accounts of personal experiences with the 'Avro 504.'

If there are any other sources of information of which I have made use and not made mention, I hope those concerned will accept this acknowledgment.

I should also very much like to put on record and express my grateful thanks to all the employees and those who assisted me in the early days.

Finally, I would wish to acknowledge the help I have had in preparing this book for publication from Mr. Gordon Cooper.

A. VERDON-ROE.

CHAPTER ONE

THE ALBATROSS GLIDES MAJESTICALLY

IT was whilst at sea as a Marine Engineer that I became convinced it was possible to construct an aeroplane. I used to spend hours, in a state of fascination, watching the albatross glide majestically with motionless wings. Little did I then realize that it was going to be my great privilege to take an active part in developing my romantic and youthful dreams.

It was by no means, however, my first thought of flight, for from my earliest days I, like many others, thought it was possible to construct a flying machine.

My father, who was a doctor, wanted me to follow in his footsteps. I was his fourth child, and was born at Patricroft, Manchester, on 26 April 1877. I am told that I ' flew '—into a rage—at three weeks old ; that my next ' flight ' was downstairs at two years old ; and I certainly remember ' flying ' over the handlebars of my high bicycle (penny-farthing) at the age of six !

My early days of youth can be told in a few words. At the age of eight I was sent to school at Haliford House, near Brooklands (which place I was to get to know so well in later years). Then I followed this by going for some terms to Shorne College in Buckinghamshire. The last part of my school education was at St. Paul's School. During my schooldays I was fond of sport and went in particularly for cycling, running, jumping, skating, and swimming. But the scholastic side of school made very little appeal to me and I did not shine at it. Thus when, at the age of fourteen, a

chance came to me to go to British Columbia to work with a Civil Engineer who was a friend of my father I eagerly seized the opportunity. I was to be taught surveying, but at the back of my mind was the feeling that I would be going out to a new land where I could have an adventurous life.

I was to sail early in March 1892. A first-class cabin had been booked for me on the S.S. *Labrador*, and my father had been assured that I would have it to myself although the fare was only £10.

My father saw me off at Willesden Junction. We made for a first-class carriage which had one occupant and who, strangely, turned out to be a fellow-passenger. He was not at all pleased, however, when he saw the same cabin number on my luggage labels as he had on his own, for he also had been promised a cabin to himself. We decided that there must be some mistake which would be rectified once we were on board.

My father had asked my fellow-passenger to look after me, but on arrival at Liverpool I was met by an aunt who drove with me in a 'growler' cab to the boat, after which she said 'good-bye' and left me. Once left to my own devices I started to explore the ship and it was not until the boat was well out to sea that I thought of looking for my cabin and finding my seat in the dining saloon. I should, of course, have done both these things when I had first come on board.

The result was that when my father inquired at the shipping office whether I had sailed safely he was told that no one of my name was on board the ship. This strange news caused great alarm at my home where they pictured me as having been robbed of my trunks and probably kidnapped. It was not until the boat called at Londonderry that they received word that I was safely on board. To-day 'wireless' would have prevented this period of silence.

The journey across the Atlantic proved to be the

roughest trip the *Labrador* had ever made up to that time, and it took us a fortnight before we reached Halifax. During the first week at sea I was very ill, but after that I became fascinated with my new surroundings and the great mountainous seas. After landing I took the train across Canada and this was also a thrilling experience for me. It took nearly a week before I finally arrived at Victoria on Vancouver Island. At that time both Winnipeg and Vancouver were hardly more than villages.

I spent a year in British Columbia, but I did very little surveying. Just after my arrival there was a great slump in silver and, in consequence, a general depression. There was little work for engineers and the outlook was bleak. However, I filled in my time at a variety of other jobs. I took on work at planting trees which brought me a wage of 16s. a day, which was a small fortune to me at my age. It was also grand work for a youngster. Then I went in for catching fish and selling them to the ships that used to come along. After a time I found I could make better profits by getting Indians to do the fishing, buying the fish from them, and selling them myself to the ships.

With spare time on my hands I bought a half-share in the local post office at Balfour and the ground it stood on. One of my jobs was to frank the letters which went out and I saw to it that my own letters were very lightly and beautifully franked with the rubber stamp so that they might arrive home in ideal stamp-collector's condition.

On going through my papers recently I found a letter written to me whilst I was in British Columbia by an old school friend whom I still see occasionally. I wonder, however, if many modern boys would write in the style he adopted, which was quite usual in the ''nineties.' Here is an extract from this letter: 'I hope you will not be taken up with new companions

as to forget me and do not take strong liquor or smoke ; you promised that in your last letter, and if you do these things you will no doubt get good and faithful companions who will stick to you through thick and thin and not rowdy ones who, while you are prospering, seem to be nice and kind fellows but if any pecuniary difficulties arise you find them melting away like mist and find yourself alone in the world. All I hope is that you will stick to your work like a man and not be tempted by anything that is put in your way but lead a straightforward life and come back to England a rich and steady man.' Yet his homely advice still stands even if the method of expressing it may have changed with the years.

In 1893 I was back home in London again. This time I was apprenticed to the Lancashire and Yorkshire Railway locomotive works at Horwich, near Manchester. It was a hard life for, I had to start work at six o'clock in the morning, but this early rising did not worry me much in those days—it does not, in fact, now—seeing that I often used to get up at four o'clock and would cycle fifty miles before breakfast on one of the first pneumatic-tyred cycles. Bicycle racing was one of my chief hobbies at that period and I did a great deal of it in my spare time, being a competitor during the week-ends and evenings at many sports meetings in various parts of the country ranging from Carlisle to Plymouth.

When I was serving my five years' apprenticeship at Horwich I won several hundreds of pounds of prizes in cycle events of various kinds. Later on these prizes were to be of great use to me financially in my aeroplane experiments, for occasionally when my friends wanted to buy a wedding present they purchased some of my cycling prizes, which offered an interesting variety.

After I had completed my apprenticeship in the locomotive works I worked at Portsmouth Dockyard

for a time. I followed this with a spell at King's College, London, where I studied marine engineering as I had the intention of joining the Navy. With this end in view I entered for the examinations which were held at the Royal Naval College, Greenwich. I succeeded in passing the engineering examination, but was turned down on some of the other subjects. I had to dismiss the Navy from my mind, and instead got an appointment as fifth engineer. My first trip was made on the S.S. *Jebba* of the British and African Royal Mail Company. I followed this by being fourth engineer on a rather poor boat, the S.S. *Cameron*. We used to call at the West African ports, where I was greatly fascinated by the tropical scenery and native life. I had imagined that I was immune from fever, but on my fourth trip I went down with a nasty attack of malaria which took some time to shake off.

On my recovery I joined the S.S. *Inchanga* of the African Royal Mail Company, which used to call at South African ports, including Cape Town and Durban. It was at this time that I first began to study seriously the question of flight. I have already mentioned how my interest was first aroused by watching the albatross in flight. If a bird could glide like this, I used to ask myself, why should not man do likewise if he was equipped with suitable apparatus. I built a wooden model of an albatross, much to the amusement of the crew, who used to jeer when the model refused to fly. I made several models and, at first, had considerable difficulty in getting them to glide satisfactorily, but succeeded eventually in making a number of different types that would fly quite well. Some of these models had their tails first (canard type) ; others had their tails behind ; and there were others with equal wing areas both fore and aft. I built monoplanes, biplanes, triplanes, and even multiplanes.

When I was at home between voyages I used to

launch my models from an upper window of our house into the garden. Then I would go down, collect them into a clothes basket, and returning upstairs would repeat the procedure—sometimes all day.

Some years later I heard an amusing story about these queer manœuvres of mine. The next house to ours was a nursing home where slightly mental patients were accepted at times. One of these, seeing me spending so much time in such a peculiar manner, said to the matron : "I am sure this is a lunatic asylum like the next house, where a patient throws things out of the window all day long."

At this stage of my life my father became quite worried over the time I was spending at my experiments and he used to say frequently : "Now, when are you going to do something serious for a living ?" At that period he certainly could not conceive any hope of aviation providing me with a career.

I was designing all sorts of things about this period. I remember going in for a Russian coupler competition for railway coaches. In my design not only was the main coupling automatic under the most trying conditions, but also all the other connections such as vacuum brakes, gas, electricity, and communication cord, etc.

I finished my period at sea by making seven voyages to Russia. Our destination was Batoum, at the eastern end of the Black Sea, where we took on a cargo of oil. I remember seeing, presumably a Russian officer, kick the soldiers, whom he treated as though they were animals. On another occasion a number of officers were sitting in the mess-room and on the table was an English magazine with a portrait of Nicholas (the Czar). An employee of the oil company who looked after the loading said, looking at the cover : "Fine man, Nicholas, fine man." Later he whispered to me, after the others had left : "Nicholas, bad man,

bad man." Later I heard that he was shot, for in those days the Russian authorities, as at present, had no kid-glove methods in dealing with possible enemies to the established order of things.

I still maintained my skill on the bicycle, and at Batoum I used to ride round the breakwater wall of the harbour doing tricks. It was about 3 feet wide with dangerous-looking rocks beneath on one side. On another occasion there was a Russian giving demonstrations of cycling tricks in a park, and finished up by riding over a rather high see-saw which was about 12 inches wide. I was requested to show what I could do and I finished up by riding over the see-saw *backwards*. I doubt if I could have accomplished it successfully a second time.

There was one time when I went for a ride into the country near Batoum. On the way back I was cycling along a footpath when I saw hiding behind a rock a few rather ferocious-looking Cossacks and Georgians with the usual assortment of slaughtering instruments dangling from their belts. I do not know if they had contemplated any attack on me, but I found laid across the footpath a heavy log which ordinarily would have compelled a cyclist to dismount near where the mixed "ruffians" were standing. I was able, however, to surmount this obstacle by means of my trick cycling. On approaching they made no attempt to rush at me, so I jumped up the front wheel and then the back as I passed over the log, a simple matter for me. The watchers were apparently too surprised after this to do anything more. So I did a few more tricks as I cycled along. Meanwhile they must have come to the conclusion they had made a bad choice.

It was in 1902 that I made up my mind to leave the sea, for my mind was filled with the problems connected with flight, and I had many ideas in connection with

the possibilities of mechanical flying. On leaving the sea I became a draughtsman in the motor-car industry, gaining experience that was to prove very useful to me in later years. I still spent all my spare time studying the problems of flight, and kept on building models of various kinds.

It was towards the end of 1903 that I first heard reports concerning the activities and experiments which the Wright Brothers were carrying on in the United States. In December 1903 I first wrote to them at Kitty Hawk in South Carolina where they were making their early attempts to drive a glider with an internal combustion engine. I told them of my own experiments and received a very nice reply from them.

A few years later, in 1909, when Wilbur Wright came to Europe and was giving flying demonstrations at Le Mans in France, I decided that I would go over to see him so that I might study his machine at first hand. I crossed over from Southampton, taking my bicycle with me, and I rode the hundred odd miles to Le Mans aerodrome. When I arrived there Wilbur Wright was advised of my presence. He remembered my name and was most kind in showing me over his machine, answering all the many questions which I asked. I felt especially honoured by this attention, for at this time he had refused many notabilities and even royalty from making an inspection of his machine. If he had done so he would have had all his time occupied in trying to answer the many silly questions which were customary in those days instead of attending to his work.

My own impressions of Wilbur Wright were that he was the quiet, silent type of man and wasted no words in his conversation. He was certainly a most thorough and determined man, but I thought, at the time, that he and his brother had given themselves a difficult task by reason of their making their balancing

surface too small and much too near the main wings of their machine.

It was in the same year (1909) that the Royal Aero Club awarded the Wright Brothers their first gold medal for services in connection with their contribution towards the advancement of aviation. It is of interest that the original machine on which they first flew is now in the South Kensington Museum and close to the early triplane on which I made many of my pioneer flights.

Those who see present-day activity in the air, read of weights up to 50 tons, speeds of about 500 miles an hour, and a flight round the world in a matter of hours, may find it difficult to realize the struggles through which the early experimenters went. Few people believed that their efforts could ever lead to success, and experimenters were regarded generally as being cranks. Engineers, even, were incredulous, and most newspapers jeered ; those in authority refused to give any help or encouragement. Even when the Wright Brothers lifted their machine into the air by engine power, few could be brought to believe what this event really foreshadowed. The great majority of people in England thought it was a Yankee yarn when they heard the story of man-made flight.

After a most interesting time with Wilbur Wright it was time for me to leave. It was evening and he kindly offered to drive me from the aerodrome to Le Mans, strapping my bicycle on the back of his car. After saying ' good-bye ' to him I mounted my machine and rode through the night to St. Malo, where I caught the next boat back to England. This trip still remains in my memory. I made it by cycle to save expense and also as I was very fond of cycling. I rode through the night as I was anxious to get back as soon as possible, for I was carrying out experiments at Lea Marshes. I remember the kindness of a French farmer who, when

I stopped at his farm-house for a drink, offered me cider and absolutely refused to take any payment for it.

It was in 1906 that I decided to burn my boats and devote my time entirely to aviation. In March of that year I applied for the post of Secretary to the Aero Club, and was interviewed by two members of the Committee, the Hon. C. S. Rolls, who was later killed in a sad flying accident at the Bournemouth Flying Meeting, and Mr. Stanley Spooner, who is so well known to the readers of *Flight*. They appointed me to the post, and it was arranged that I should take up my duties in April. Looking back now I feel that the other applicants for the position must have been hardly a brilliant lot, for I had no pretence whatsoever to secretarial qualifications, as I told my interviewers at the time, and the only inducement I could offer was my intense interest in the question of aerial development. This was, in fact, rather a poor qualification to offer, since my ideas of development were along 'heavier-than-air' lines, whilst the Aero Club, at that time, devoted its activities entirely to ballooning.

Whilst I was being interviewed there remained waiting outside the room in which we were a much older applicant. Suddenly Rolls remembered him, for after we had been talking for some time, he exclaimed: "For goodness sake, Spooner, go and speak to that old man; he's getting older and older every minute."

I only held the appointment of Secretary of the Aero Club for a few days. It happened that shortly before I had written a letter to *The Times* which they had published and in which I had tried to combat the scepticism which then existed in England on the matter of aviation. I mentioned the tests I had made with aeroplane models driven by elastic, and I urged that experimental work should be taken up seriously in this country. As a result of this I received a letter

from a Mr. Davidson who had read my letter and wished to meet me. He made an appointment at the Junior Carlton Club, where I met him, with the result that he offered me a post as draughtsman in the building of a large helicopter which he had invented. He wanted me to start work immediately at his rooms in Jermyn Street. I accepted his offer, and thus gave up the quiet and congenial position which I had hoped to maintain at the Aero Club. Spooner and Rolls were good enough to release me from the position.

When I had been working in Jermyn Street for about a week, Mr. Davidson brought in Lord Armstrong (of ' Armstrong-Whitworth ' fame) to see the work on which I was engaged. It appeared that he was financing the helicopter, which they had decided to build in America, and they wanted me to sail for that country in the following week. To this I agreed, and accordingly embarked once more for the New World in the company of Mr. Davidson.

CHAPTER TWO

FIRST FLYING PRIZE

ON my second crossing to the American continent I travelled both more comfortably and without the 'adventure' which had marked my first journey. On arrival we made for our destination which was Denver in Colorado, near which Mr. Davidson had rented a modern stone building called 'Nichol's Castle.' The place was architecturally rather strange, for in the three-storied building I found that the kitchen was on the top floor with the living-rooms beneath. The idea, of course, being that all cooking aromas should pass freely upwards and outwards into the fresh air without contaminating the rest of the atmosphere within the house; an excellent idea.

I had little opportunity for studying American life at that period and my main memory is of the size of their papers, especially the Sunday editions. Even in those days, over thirty years ago, they numbered eighty pages. Since then they have kept on increasing until at the present time a Sunday paper may run into two or three hundred pages, which even the most assiduous reader could hardly hope to consume in one day.

We wasted no time on arrival in getting to work. I was extremely interested in what I had to do in designing, but, as I ventured to point out to Mr. Davidson, I could not help feeling that the problem was being approached from the wrong angle and that something on the lines of a glider would prove more

likely to lead to success than the helicopter on which we were engaged.

Mr. Davidson, however, was not prepared to change his ideas or to be diverted from his belief, so I found myself making a number of fine pitch propellers which, when started off at different speeds and angles, could be made to take a chosen course in any direction during the first portion of their flight, so there appeared to be a possibility that something might be accomplished along this line of research.

The Davidson helicopter was a large and heavy piece of apparatus, as the scheme did not lend itself to light construction. It had two 30-foot lifters with 120 blades in each ; these surfaces being driven through gearing by a couple of 20 h.p. 'Stanley' steam-engines. Before this big helicopter was finished, however, I had to leave Colorado as Mr. Davidson wanted me to return to London in order to arrange about taking out British patents. Thus I never saw any trials of the machine, but I learned subsequently that when it was completed, and on an occasion when Mr. Davidson himself was absent, some of the engineers started up the engines, which caused the helicopter to lift itself into the air suddenly, and in its descent was damaged. On arrival back in London once more I had first to finish my work on the patent drawings. It was some little time, however, before Mr. Davidson returned to England and I got payment of the salary due me. I then was for a short time without employment.

. . . . .

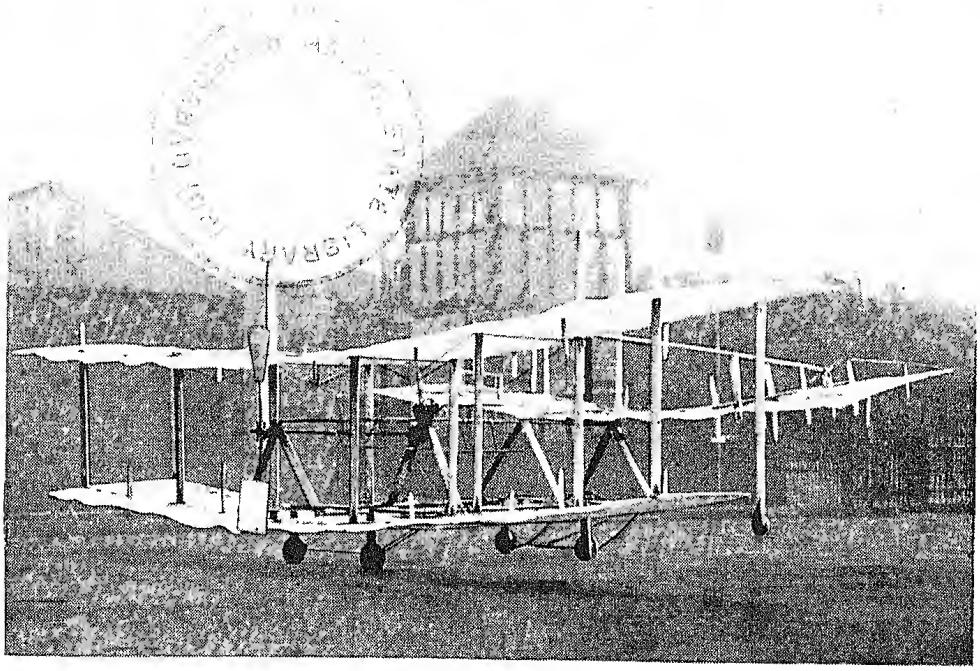
It was at this time that aviation, at last, found a friend. The late Lord Northcliffe, a man of immense vision, realized the world-importance of flying, and, through his newspaper, the *Daily Mail*, offered £250 in prizes for model aeroplanes capable of mechanical

flight. Here was the chance I had been waiting for, and I immediately entered three models of my own. In March 1907, when the entry lists were closed, I was, however, chagrined to read that over 200 entries had been received for the competition, and it seemed to me that with so many machines I would stand small chance of being successful.

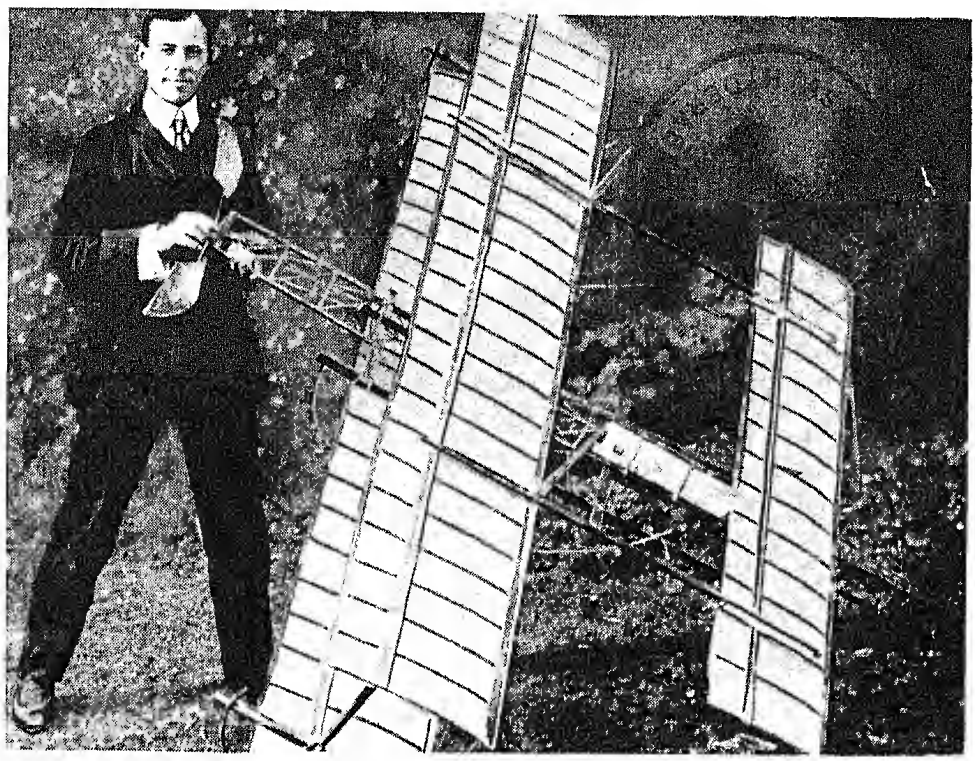
I constructed my three models in the stable of my brother's (Dr. S. Verdon-Roe) home on West Hill, Putney, and tested them in the back garden. I got all my three machines to fly succesfully, and when the contest came to be judged I was given the highest-awarded prize. My winning machine was a 'pusher' biplane of the front elevator type. This model had a span of 8 feet, and the length of twisted elastic which was the motive power being encased in a braced frame of triangular section 8 feet in length. This machine flew over a 100 feet. To-day any boy can buy a small model for a few shillings which will fly for a considerably greater distance, but at the *Daily Mail* Exhibition, which was held in the Agricultural Hall with the flying tests conducted on the slopes of the Alexandra Palace, barely half a dozen of the models shown would fly more than a few feet.

In my winning model, the fuselage containing the rubber elastic was of triangular section with lattice-girder construction. It had to take a very heavy compression load. There was a large elevator attached to the top plane by two booms ; it was held rigid by king-posts and bracing-wires, the inclination of the elevator being adjustable at two points, so that a twist or warp could be obtained for turning to the right or left. Wire was chiefly used for bracing the machine, and the wings were covered with oiled paper.

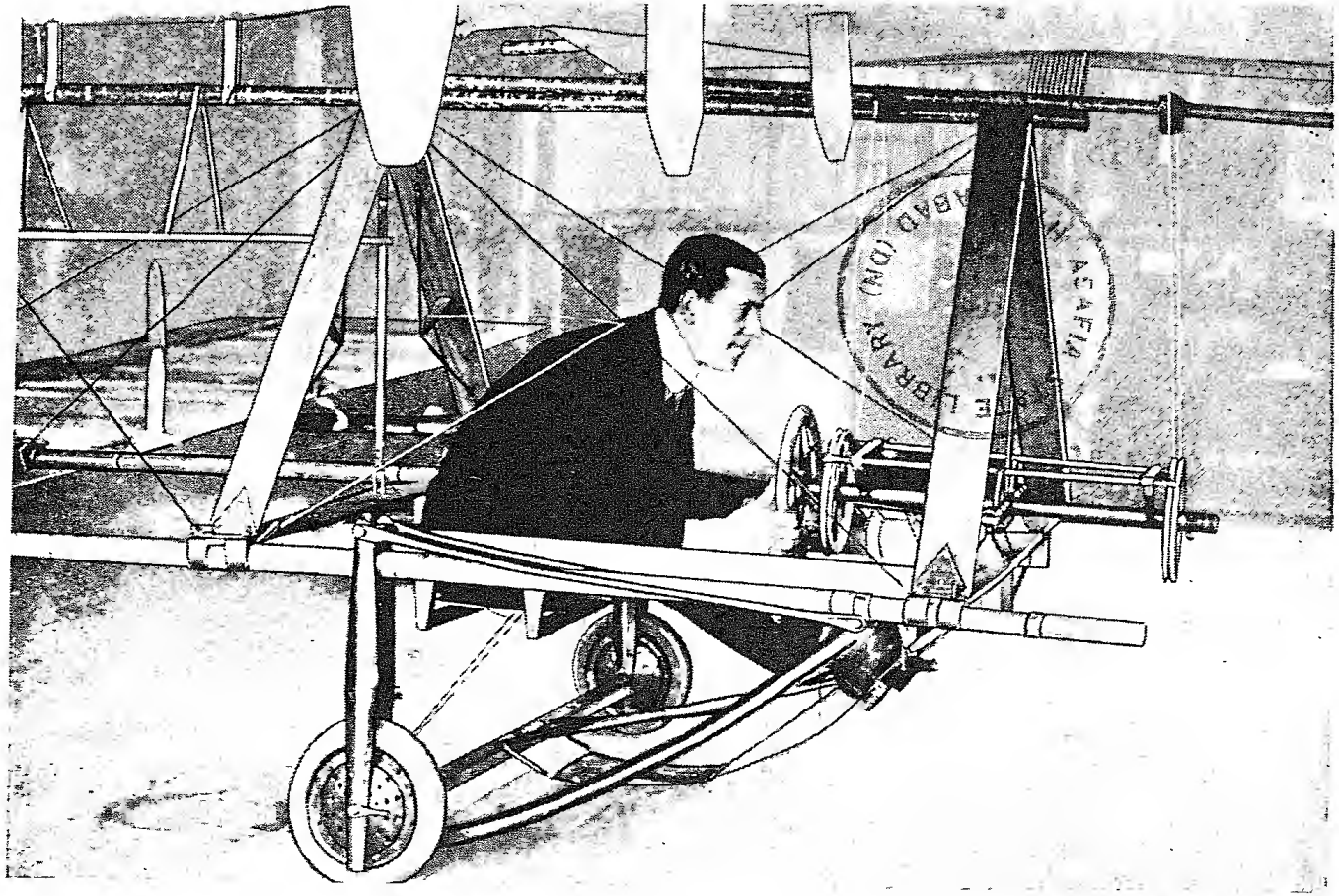
Prior to the flying trials I took a stroll round the Agricultural Hall to see what my rivals had produced. Actually I found that apart from the beautifully made



MY FIRST POWER-DRIVEN MAN-CARRYING MACHINE
(BROOKLANDS, 1907)
Photo shows ' J.A.P.' engine. Flown with eight-cylinder 24 h.p.
' Antoinette ' engine.



A. V-R. WITH THE MODEL AEROPLANE WITH WHICH HE WON CHIEF PRIZE AT *DAILY MAIL* COMPETITION IN 1907



By courtesy of 'Flight'

THE STEERING METHOD PATENTED BY A. V-R. IN 1906, THE FIRST COMBINING LATERAL AND ELEVATOR CONTROL IN ONE COLUMN

Clarke and Weiss machines the others were mostly freakish. Major B. Baden-Powell, who was one of the early balloonists and made many valuable contributions to the knowledge and science of ballooning, had a helicopter on exhibition. This machine was about 2 feet in diameter and was driven by wound-up elastic. Its flying efforts were, however, strange and caused great amusement amongst onlookers, for the helicopter fluttered and danced about on the floor, looking frightfully dangerous.

Whilst I was engaged at looking at the machines on view I came across the Hon. C. S. Rolls, who told me he had been commissioned by the Editor of the *Daily Mail* to write for them a special article about the competition, and asked me if I would tell him my opinion on the virtues or otherwise of the various models at the Exhibition. We made a tour of the hall together, examining the exhibits carefully, and, finally, he asked me which one was most deserving of the gold medal to be awarded by the Aero Club. I replied that modesty prevented my telling him, but that the matter would very soon be settled at the trials. I did mention that Short Brothers, whom he was financing, had some beautifully spliced rope and basket-work on view, but that as this was intended to be a model aeroplane exhibition and competition I thought the medals should be reserved for them only.

The next day his article appeared in the *Daily Mail* printed under a prominent heading.

In the tests at the Alexandra Palace the models were required to fly 100 feet before they could qualify for the first prize. My three machines made good flights. My winning machine exceeded this distance, and as no other competitor succeeded in beating my record, I was awarded the chief prize which the judges decided should be £75. Actually the first prize should have been £150, but the judges took the view, apparently,

that none of the models had shown sufficient merit to justify the award of the full sum. There was a proposal that a further competition should be held to enable this £150 to be won, but nothing more was done about the matter.

I felt at the time, and I still feel, that I should have been given this bigger sum as first prize, and also the second and third prizes as all my models performed better than any of the others at the trials. In this regard I could not help feeling it was unfortunate that the judges, although all of them were well-known aeronauts, were more interested in ballooning than in any experimental work with heavier-than-air machines. They certainly did not seem to realize the difficulties with which one was confronted at that time in making a model aeroplane fly. I have suffered what I consider to be four gross miscarriages of justice by this Club's judges, and this was the first case.

About twelve months later the French held a similar competition in Paris, and Mr. (now Commander) Perrin, who went over there to represent the Aero Club, told me on his return that the best models there did not fly half as well as the winning machines at the Alexandra Palace. Nor, in his opinion, did the construction of the French machines inspire much confidence in the designing skill of the competitors.

To revert, however, to the *Daily Mail* exhibition, the Aero Club's gold medal went to the Short Brothers for their balloon exhibit. The silver medal was awarded to Mr. Tani for a wonderful contraption which included in its make-up two electro-plated bowls, some beautifully polished clock-work wheels, and some glass lenses, the whole apparatus being shown under a glass case. What it was supposed to be it is difficult to say. But I understood the prize was awarded for workmanship. Then there was the bronze medal which went to a postman for some silk

stretched on bamboo sticks in the form of a feather which would, in any endeavour to beat the air down, slide horizontally ; when put into two sockets with a crank-handle attached, this contraption could be revolved, creating a draught ! This was the second case of what I considered to be a miscarriage of justice.

CHAPTER THREE

FIRST FLIGHT

AS a result of winning the *Daily Mail* prize of £75, I decided to commence work on a full-size, man-carrying, engined machine for I was now confident that my models were being developed along possible lines.

About a year previously I had written a letter to *The Times*, stating my theory of flight, and also giving my absolute belief in the 20-mile flight of the Wright Brothers (which many people then doubted). At the same time I pointed out the successful results I had achieved with my models. I added that if it were possible to make a model fly, it was even more feasible to make a full-size machine, driven by an engine turning a propeller, and balanced and guided by someone on board. 'It would,' I wrote, 'perform exactly the same feat.'

My letter was published in the Engineering Supplement of 24 Jan. 1906, although it was pointed out that it was not usual for them to give free advertisements, but in view of the interesting nature of my letter they had decided to make an exception.

When it was published, however, the Engineering Editor added the following footnote beneath my letter :

> 'It is not to be supposed that we can in any way adopt the writer's estimate of his undertaking, being of the opinion, indeed, that all attempts at artificial

aviation on the basis he describes, are not only dangerous to human life, but foredoomed to failure from an engineering standpoint.'

This was certainly not encouraging, but in spite of this expert condemnation I continued my experiments and I devoted all my time in building a full-size aeroplane. This first effort was built on the lines of my winning model. The machine was a front-elevator biplane and, as worked out originally, the motor was to have been right forward in front of the pilot, a shaft passing under his seat to a sprocket, which was to have been connected to another sprocket on the propeller-shaft by chain transmission, the propeller at the rear of the machine having its boss about midway between the main planes. But to simplify construction I had to place myself forward instead of the motor, the engine being actually amidships, driving its air-screw direct through about five feet of shafting. The machine was fitted with a very large front elevator which could be warped or tilted, being controlled with a single steering column. This column was twisted for warping and tilted up and down for altering the angle of the elevator.

This was the first system which combined the two movements, rising or descending and lateral control. And it corresponded to warping the wings or moving the ailerons and operating the elevators, which is the universal control of nearly all aeroplanes to-day.

I took out a patent for this control, it being the first patent application in the world combining a dual control in one steering column. About a year later M. Robert Esnault-Pelterie of Paris, maker of the 'R.E.P.' monoplane, took out a patent for a much cruder arrangement, as two separate sticks were used, one being controlled by the right hand and the other by the left. Apparently unaware of my previous patent,

Esnault-Pelterie considered he had a case for infringement, and later on claimed huge royalties from certain makers of aeroplanes. In my own case I received a letter from him personally, after the War, claiming £1,000,000. According to his estimate, a reasonable royalty per 'Avro' would produce this sum on account of the large numbers we had built.

As it was a matter for the Air Ministry to deal with I handed the letter over together with a copy of my original patent specification, contending that there was not sufficient subject matter, in view of my prior claim, to constitute invention. Calling at the Air Ministry later on, I inquired if the matter had been settled. I was informed that it had been. I asked if Esnault-Pelterie had been given an award and was told he had and that the amount was confidential. I contended there was no need to pay in view of my prior patent, but was informed that it would have cost £40,000 to fight the case.

Suitable strainers were unobtainable at that period so I made my own, using cycle nipples and spokes, the latter were cut down to within three inches of the head and re-screwed, the fork piece which held the nipple in a socket being cut or pressed out of sheet metal. This was the birth of the 'Avro' strainer, which I subsequently tried to persuade the War Office and Admiralty to take up, but without success, before the creation of the Air Ministry.

However, during the War the aircraft industry was held up not only owing to the difficulty of obtaining delivery of the more costly standard strainer, but the special tools required to make same. So we were then given orders to provide our strainer, the 'Avro,' and made them by the million, selling them considerably cheaper. They could be used direct on levers, and thus save the costly machined fork end or separate links. Chobert took up the patent rights in France where

they were universally used. We made over £40,000 profit a year on the 'Avro' strainer for several years.

To revert, however, to my first machine. It was mounted on four small wheels which I hammered out of sheet metal, the pneumatic tyre was held on by bolting two discs together by a number of small bolts, which not only retained the tyre in position, but the hub as well. The front wheels could be steered with the legs, which is rather interesting in view of the modern tricycle undercarriage. As a covering I used fine cotton fabric, sizing it well to make it air-tight. This fabric was placed on the underside of the wing structure, and to reduce the resistance of the wing-spars, I made them of streamline section. This meant frequent kingposting, but the kingposts were also carefully streamlined, and, in some cases, I even used flat clock-spring to lessen head resistance.

At that time the authorities at Brooklands were offering a prize of £2500 to the first aviator who flew round their track before the end of 1907. In September 1907 I decided to take my machine there, hoping to win this prize as soon as the motor-racing ended. After a considerable amount of trouble I finally obtained permission to erect a shed for my machine alongside the finishing straight, close to the judges' box, though the manager of the track eyed me with a great deal of disfavour, and made things as difficult as possible.

A well-known figure in early motor-racing, Mr. Rodakowsky, was in charge of the track at that time, and as there were no microphones or loud speakers in those days it was essential that he should have a penetrating voice for calling out his orders and directions. Mr. Rodakowsky was so well equipped by Nature in this respect that it was said that even when he whispered you could hear him on the other side of the track.

One of the things I wanted to know, before moving my machine to Brooklands, was where my shed was to be situated. I have mentioned that I was given permission to erect it not far from the judges' box. It was an excellent position, but I was doubtful whether I should be allowed to stay there when the motor-racing started again. I did not fancy having to move my shed about as it had a stoutly-built wooden floor. I questioned Mr. Rodakowsky about the matter, but all I could get out of him was one of his famous 'whispers': "You put it there, or nowhere." So I accepted his offer and erected my shed on the spot he had indicated.

The shed itself was nicely built and made a good workshop. During the cold weather, however, it became decidedly chilly so I had an old bucket with a coke fire to warm not only my hands, but the handles of my tools. The coke fire cheered one up although the smoke was not very pleasant.

The first engine I had fitted to my machine was a 9 h.p. 'J.A.P.,' but it was not sufficiently powerful to get me off the ground although it gave me opportunities of testing propellers and taxi-ing about. I, therefore, arranged to have the use, on loan, of a 24 h.p. 'Antoinette' motor, designed and built by that great engineer Levavasseur, which had copper water-jackets and direct petrol injection. It was to come over from France.

While I awaited its arrival I had no difficulty in getting sympathetic motorists to tow me off the ground in some short straight 'hops.' These towed 'hops' had the advantage that they accustomed me to the controls of my machine while actually in the air. But while I appreciated the kindness of these motorists, yet I had great difficulty in inducing them to let go my machine when it began to swerve in the air. Often they held on with embarrassing tenacity with

the result that some of my towed 'hops' ended in a dive and a crash which damaged my machine to such an extent that several days' work were needed to put it right. In the end I fitted a quick-release device which I was able to control from the pilot's seat. On one occasion I struck the wire spiked railings, which fence off the finishing straight, fortunately without injuring myself.

Towards the end of 1907 I was joined at Brooklands by another flying pioneer when Mr. (now Lieut.-Col.) J. T. C. Moore-Brabazon had a shed built alongside mine. Up to that time I had been quite alone, apart from a robin which used to visit me and feed out of my hand. Moore-Brabazon's machine had been built by Short Brothers, then makers of balloons. It had a 'Buchet' engine, rudders at the side, and a trailing floppy 'stabilizing' plane in addition to the elevator. It had a decidedly weak under-carriage, as supplied. This was replaced by a new one, which was made at a Weybridge garage. The mechanic designed a new under-carriage and assisted in its construction. When this landing gear was ready he was going to wire to Moore-Brabazon to come and try the machine. But I suggested, as a precautionary measure, that he should take the trestles away first to see how the machine stood up to its new gear. This he agreed would be a *good idea*, but immediately the trestles were removed the under-carriage collapsed.

After this another and stronger chassis was designed and built; and as the machine appeared capable of standing up all right on this one, a wire was sent to Moore-Brabazon telling him that everything was ready for a trial. He arrived, but when he saw his prospective mount he looked rather worried, which was hardly surprising if one had seen the machine. However, his anxiety was short-lived. The aeroplane was wheeled out, the engine started up with a roar, and

Moore-Brabazon took his seat at the controls. He gradually increased the opening of the throttle, but at first the machine showed no signs of moving even when the throttle was wide open. Then, at last, it began to taxi slowly forward at a speed of about two miles an hour. After travelling some 15 feet the under-carriage again collapsed under the strain! Moore-Brabazon quickly switched off the engine and climbed out of the seat. The mechanic apologized for the under-carriage failure, but Moore-Brabazon, looking very relieved, just said: "These things will happen." It was decided to scrap this machine and Moore-Brabazon shortly afterwards left for Eastchurch, where about two years afterwards he qualified to become the proud possessor of the first British Aviator's Certificate issued by the Aero Club, now the Royal Aero Club.

At last, early in 1908, the 24 h.p. eight-cylinder 'Antoinette' engine arrived. It weighed 98 lb. without the radiator. The cylinder heads were of aluminium. But it had come too late for me to try and compete for the £2500 prize, as the final closing date had expired. Then as the motor-racing season was shortly due to start again I was given notice to quit Brooklands. This was a serious matter for me, as the 40 by 20 foot shed, with its floor, had absorbed a good deal of my small capital. Finally, however, Mr. Rodakowsky allowed me to stay provided I moved my shed to the other side of the paddock, and painted it dark green, which I did. It was an awkward business erecting the shed again, for it had to be built on about four feet of piles to bring it level with the paddock, and above high-water mark during floods. I painted the shed green and when Rodakowsky saw it he said it was not dark enough.

I was forbidden to sleep in the hangar, and in order to do so without detection I used to bid the gate-keeper 'Good night,' pass out, and later climb back

over the fence, and return to my shed so that I could start early-morning trials as soon as it was daylight. It was necessary for me at that time to make my trials in the early hours, when there was little wind about. It used to take me two hours to get my machine out single-handed, and another two hours to house it again. If I did not finish my attempts at flight on the track before anyone turned up with a car there were 'ructions.'

Those early days at Brooklands were full of hope, hard work, and disappointment. It was the simple life also, for I used to live on about five shillings' worth of food a week. My diet consisted of dates, kippers, bacon, and perhaps half a pound of best rump steak which used to last me the week. Fortunately, I am not a great meat-eater. My bed in which I slept was concealed in a large box. In the winter it was extremely cold—especially when it froze. But perhaps my life at sea enabled me to face these hardships more easily than some persons might have done.

I remember one particular night, when a severe storm blew up. There was a gale, lightning, and terrific rain. I had to rush out and try and prevent my machine from being blown away. I tied it down with trestles, bags, and anything else I could lay my hands on. It was a terrible night, but my machine went through the ordeal safely.

Another difficulty that I experienced was caused by my having been moved to the paddock, for there was a five-foot spiked fence separating me from the track, the usual gates were not sufficiently wide to permit my machine to pass through them. This meant that either my machine had to be lifted over these railings or that a portion of the railing itself had to be made detachable. I approached Mr. Rodakowsky, offering to have a section of the fence made removable at my own expense. But this he refused to sanction. I

decided, therefore, that I must resort to desperate measures in the good cause, so one night secretly made a section of these railings detachable ; and no one but myself was any the wiser.

That problem had been solved, but there were more to come. One morning Rodakowsky came over to me and asked whether I would object to my shed being used as an extra refreshment room during the days of motor-racing. I told him I was agreeable, and it was arranged that I should be given the sum of ten shillings for the use of my shed. This meant removing my machine from it while it was being used as a refreshment buffet ; and it also led to a somewhat regrettable incident from my own point of view.

At the next meeting I had removed my machine, placing it in an unused corner of the paddock. About ten o'clock in the morning Rodakowsky came on to the scene.

" What's that machine doing there ? " he shouted at me.

" Where else could I put it ? " was my reply.

" I'll soon settle that," was his answer in a tone which was boiling with indignation.

A ' whisper ' from him brought a number of policemen and attendants hurrying forward. Rodakowsky gave them the order to lift the machine over the railings into the field at the back. When they had got it over the fence he told them to take it still further back, evidently not wishing to offend his patrons who had come to see motor cars, not aeroplanes. My machine was carried until the bearers reached a dried-out dyke nearby which zigzagged through Brooklands before the aerodrome was built. Here they paused, but this did not satisfy Rodakowsky who kept on bellowing : " Further back, further back," consequently, as might have been expected, they stumbled in attempting the crossing, with the result that my

machine was damaged. Rodakowsky, seeing that I was very upset, apparently had some qualms of conscience and felt sorry, for he said he would compensate me for the damage done, but, in fact, it never materialized. On the contrary, I could not induce him, when leaving the track, to give me more than a small fraction of its cost, although it was badly needed by then ; more anent further on.

. . . . .

Many memories throng my mind when I think of my early flying days at Brooklands. Sometimes, when going up and down by train between London and Weybridge, I used to meet Mr. (now Colonel) Mervyn O'Gorman, and in view of my then precarious position in the field of aeronautics, I used to envy him his official post as Superintendent of the Royal Aircraft Factory, Farnborough, now called Royal Aircraft Establishment. When in conversation with such Government officials and experts I could not help feeling that I was looked upon as being an interloper, and that in their opinion—though they did not actually say so—the problems of aeronautics should be exclusively reserved for official research. During one of these train journeys I remember Mr. O'Gorman expressing the view that it would be desirable for the Royal Aircraft Factory to make the bulk of the aeroplanes for the Government ; the aircraft industry being given orders for only a small proportion. It is certainly fortunate that such a project failed to materialize.

In the spring of 1908 I found myself with my aeroplane repaired and with my new 'Antoinette' engine fitted to it. The machine itself measured 36 feet from tip to tip of its planes, and 20 feet fore and aft. With myself on board the weight was only 450 lb.

As soon as I had installed the more powerful engine, I began a fresh series of experiments. For a time I

was hindered by propeller trouble. My blades sometimes developed the awkward habit of breaking off suddenly and shooting into space. I soon realized what had happened when I heard my motor race, and switched it off instantly.

One day the usual symptoms having developed, namely, the engine suddenly began to roar away, so I switched off the engine and left the pilot's seat, walking casually round to the back of the machine to ascertain the extent of the damage. While I was examining the propeller-boss I heard a 'swish' in the air near me, and something fell on the ground just to my left. It was one of the propeller blades. Just for a moment I had thought someone was hiding behind one of the bushes close by and had thrown it at me. I felt very indignant, thinking what a foolish thing to do. Then it dawned on me that this blade, after an unusually lofty flight, had chosen to return to earth in disconcerting proximity to where I was standing.

Having cured this trouble, and also others, I began to make definite progress. It was on 8 June 1908 that I was able to realize my dreams by making some of the first short aeroplane flights in England.

On the occasion of the first flight I had made no special arrangements, for it took place during one of my many routine trials. I had been taxi-ing along the track at Brooklands when I realized that I was clear off the ground, not only with my front wheels, as I had been before, but with the rear ones too.

I was flying for the first time.

Those few seconds of life gave me a most exhilarated feeling of triumph and conquest which more than repaid me for all my previous trials and disappointments. Achievement after incessant difficulties and obstacles is invariably sweeter than easily-attained success for those who accomplish it. On this occasion I had a feeling of ecstasy which is difficult to describe.

My flight in the air was over a distance of about 150 feet, and I made a perfectly smooth landing. Several more attempts were made with very much the same results each time.

As I had not arranged for official observers to be present my flight was not officially recorded. I did not even know whether anyone had seen my machine leave the ground, and it looked as though I might not be *able* to substantiate my flight. Luckily, however, as I ascertained some time afterwards, both the head carpenter and gate-keeper and a friend of theirs had seen me make these flights, and I was able subsequently to obtain signed statements from them to this effect.

On 8 June 1928, twenty years later, the Royal Aero Club, the Royal Aeronautical Society, the Air League of the British Empire, and the Society of British Aircraft Constructors very kindly gave a banquet to me at the Savoy Hotel ; which the Duke of York, now King George VI, graciously attended when the dancing commenced. This started a controversy as regards who flew first in England. A committee was formed by the Royal Aero Club to establish historically the date of the first flight in the British Isles, and my efforts were ruled out as the committee did not apparently think I had flown sufficiently far to constitute a flight, and they considered that the first official flight was made by Moore-Brabazon on a Voisin biplane at Eastchurch nearly a year later.

Soon after this decision I requested the stress department of Saunders-Roe, Ltd., to work out what distance would constitute a flight by my first machine, and without being in any way favourable, it was calculated that my machine could not do even 70 feet without having flown.

. . . . .

That first triumph of mine was followed—as so often happens in this world—by a further rebuff at the hands of Fate.

I received another notice to quit Brooklands. This was the final blow that my early flying days at this place were doomed to receive. This time there was to be no compromise, no reprieve. They simply did not want me to remain on there at any cost. I was regarded as a nuisance—as a liability rather than as an asset. This time, in short, I really had to go. But there was the question of my shed which I found would prove a costly business to move, so I parted with it for a few pounds to the Brooklands authorities. Although it was worth very much more than I was offered, yet I had to accept. And there it stood for years. It has been moved now, but it is still in use at the present time (1939), as a reminder to me, at any rate, of those early struggles in which aviation was looked upon as a rather fantastic form of suicide and any would-be airman as a reckless adventurer. I often see the shed, red roof and blue sides, as I travel by rail between Waterloo and Southampton.

I still have some parts of my original machine among my aeronautical collection, kept at home in a large cupboard with glass doors. The parts are interesting, as modern methods were employed in fashioning some of them. For instance, rigidity was obtained when using thin sheet metal by curving the free edge, and generally taking advantage of curvature and double curvature. Hollow rivets made from copper tubing were used in places.

Each time I pass Brooklands my memory goes back just over thirty odd years ago to the time when I was designer, builder, labourer, pilot and a hundred and one other things. Professor C. E. M. Joad once stated that " the superman made the first aeroplane and the ape has got hold of it." He was contrasting the marvel

of man's powers and the imbecility which he brings to the use of them, holding up the aeroplane as a symbol of this contrast, as one of the greatest of man's inventions, which, nevertheless, threatens his civilization with destruction.

But obviously the people who made the first aeroplanes and carried out the early pioneer work were not supermen. Most of us were great enthusiasts whose main object in life was to make machines fly. I look upon Abraham Lincoln, and Andrew Jackson before him, as supermen, as they predicted all that is happening now. They both said so long as nations fail to exercise their prerogative over the creation and issue of the currency in a proper manner, and permit bankers and international financiers (bankers) to create nearly *all* the currency (which they are able to do owing to the present method of using cheques. See Chapters fourteen and fifteen), that it would lead to appalling indebtedness, crushing taxation, strife, and war.

In *The Aeroplane* of 14 September 1938, C. G. Grey, the editor, wrote on this subject thus: '. . . They (the pioneers) would be the last people to claim any relationship with supermen. In America the Wright brothers were simply cycle mechanics, and their great and successful rival, Glen Curtiss, was a motor-cycle builder and racer. In France Blériot was a maker of motor-car lamps and the Nieuport brothers and the Morane brothers and the Voisin brothers were just well-to-do young sportsmen. The German Rumpler was in the motor-car trade. In Austria Etrich was some kind of engineer.

'Anything less like supermen cannot be imagined. Few were even men of scientific attainment. None of them had any inspirations. Most of them were just dull plodders. And one has only to look at their early designs and compare them with what we know even in our lamentably absurd ignorance to-day, to

see how little imagination they had and how feeble was their knowledge of aerodynamics, compared with what Caley knew in 1808, and what Horatio Phillips knew in 1860, and what Stringfellow and Henson knew in 1840. The outstanding genius of all was old man Levavasseur who built the lovely 'Antoinette' monoplanes in 1909-10-11 and 12, with their steam-cooled, direct-injection motors.

'The one thing that distinguished the whole lot of them from the normal sub-human inhabitant of the countries in which they worked was the fact that they were all honest seekers after truth. And to the extent that the average human being is sub-human we may, by a stretch of imagination, call the pioneers of aviation supermen, assuming that the normal man, like normal eyesight, is the most abnormal thing in the world.'

I certainly think that the early flying pioneers were all honest seekers after truth.

CHAPTER FOUR

TRIALS OF A PIONEER

WHEN the time came for me to leave Brooklands I was in a considerable quandary. I felt that I had obtained encouraging results with my first power-driven machine, but I was by no means satisfied with it as I had already prepared designs for what I considered would be a much better type, and this was to prove subsequently to be the universally accepted system, namely, the tractor type with the engine in the nose of the machine, main planes forward, and a tail at the end of the fuselage.

At that time I considered that the front-elevator type of aeroplane such as the Wrights were building in America, and Cody was building in England, was on the wrong lines, so I resolved to start all over again.

With my mind made up on this matter of construction I decided not to spend any more time on my original machine, but to devote all my attention on building a small tractor triplane. My brother, Dr. S. Verdon-Roe, agreed to let me use his stables at Putney, where I was able to begin the construction of the new machine. But it was one thing in those days to build a machine, and quite another thing to find a suitable place in which to carry out one's flying trials.

At that time the late Colonel Cody was experimenting with kites and proposed to build a big biplane on Laffan's Plain, so I thought I was making a reasonable

request when I asked the War Office if I might be allowed to erect a shed on the Plain close to his. But they refused.

At the time this refusal made me feel very sore. I liked Cody very much, personally, and greatly admired his pluck and perseverance ; but it did not seem at all fair that an American experimenter should receive more favourable treatment than an Englishman working in the same line of research. Aviation, however, was not taken seriously in those days, and much was to happen before its potentialities began to be grasped by our Powers-that-Be.

The path of the air pioneer was certainly hard. Nobody wanted him and he was driven from pillar to post. I next asked to be allowed to use Wormwood Scrubs, but I was again refused. Then I applied for permission to carry out my trials on Wimbledon Common and this, likewise, was barred to me. I then began to study the maps of London districts and decided to use the Lea Marshes where there were fields open to the public and where I was able to rent a couple of railway arches under which I could house my machine. Two of these I boarded in at comparatively small cost.

It was early in 1909 that I emigrated to my new flying ground. I had been obliged to return the 24 h.p. 'Antoinette' engine, as I could not afford to buy it. In my new triplane I had to be content with a heavy 9 h.p. 'J.A.P.' motor-cycle engine. Even with this low horse-power I began to make encouraging progress.

By this time I had gathered around me a faithful band of assistants, or perhaps I should call them fellow-adventurers, for they were attracted more by the nature of the work rather than by the small wages which I could ill afford to pay from my declining savings. By all trade union conditions I would have been termed

an employer of sweated, ill-paid labour, but no one seemed to mind. It was only the job that mattered.

Among these helpers of mine were Howard Flanders, who later built aeroplanes on his own account at Brooklands, and the late E. V. B. Fisher, who was a very striking personality with the face of a poet and masses of fine black hair. When he first arrived and we had our initial 'crash' he was most terribly crest-fallen. "What a shame, what a shame," he kept on exclaiming. But it was not long before he, like myself, thought nothing of it when we had our regular 'crashes.'

There were other persons helping me, but I regret I cannot recall their names. Judging by the letters I get from time to time there appears to be a great number of people who claim to have helped me in the early days.

I will never forget how broken-hearted we all were after my first crash at Lea Marshes, and how quickly we acclimatized ourselves to these disasters. We soon realized that there was nothing else to expect and felt very lucky if we ended the day's trials without a crash. Sometimes one of my assistants would even follow the machine on a bicycle with a fire extinguisher in case of fire breaking out—a not infrequent occurrence.

It was on 13 July 1909 that I made my first 'hop' of about 100 feet in my new triplane at this flying ground. This was the first flight by a British aeroplane and a British engine in England. Two days later I repeated the performance, and a photograph of my machine in the air appeared in the *Daily Mail*. On other occasions I made flights of 300 feet and over at heights ranging from 6 to 10 feet from the ground. It is interesting when looking back on these triplane flights, with only a 9 h.p. engine, to remember that it was not until fourteen years later, in 1923, that any other such low-powered flights were again attempted

in England. Actually my triplane, although of curious and primitive construction, more nearly resembled modern aeroplanes than any other machine of that period.

It may be of interest if I give a brief description of the main features of my original 9 h.p. triplane which can now be seen in the South Kensington Museum near to the Wright Brothers' original machine. It had many novel features. It was a tractor type with a triangular-section fuselage built up on three longerons or booms. Welding was then unknown for aircraft fittings, and the joints were made with bent plate, the whole structure being braced with piano wire. The compression struts on the fuselage were all tapered at the ends, and fitted with ferrules and spikes. Then, put into compression by the tightening-up of the bracing wires, the spiked ends passed through holes drilled in the bracing plates, and bit on to metal plates mounted on the wooden booms beneath. The bracing wires were tightened by our own original home-made strainers which I have already described previously.

The propeller of the triplane was fitted to a counter-shaft mounting some 3 feet above the engine pulley, and driven by a motor-cycle belt or chain. Sometimes the former was used with pulleys. At other times sprockets were fitted, and the latter drive employed, various pulleys being tried giving different gear ratios.

By this time I had cured the propellers of their blade-shedding propensities which they had exhibited at Brooklands. I found that eighteen mild-steel pins of $\frac{1}{8}$-inch diameter were sufficient to hold the blade in the boss against any normal load. I obtained propeller-pitch variations by drilling some hundred-odd holes in the propeller-boss sockets, and when the blade was set to the correct pitch picking up any holes that registered, and drilling the rest, till the eighteen pins were all in position. I experimented on this machine

with both two- and four-bladed propellers. Lateral control was by wing-warping, and the fore and aft control by increasing the angle of incidence of sometimes both the main planes and the tail together. Directional control was by means of a rudder. The petrol tank was slung on elastic straps in order to reduce the shock on landing. The seat was also sprung. The main members of the undercarriage were reversed cycle forks in conjunction with coiled springs, and were fitted to give a castor action. Finally, I should mention that the fabric used on the wings was yellow-cotton oiled paper, which cost about twopence a square yard. The cost of aeroplanes in those days are in strange contrast to the cost of many of our present-day machines. Shillings almost compared to pounds, but, of course, no real comparison is possible. To-day the early flying machines would be deemed so dangerous that they would never pass factory inspectors and I doubt if many would care to risk flight in one.

Although the Lea Marshes afforded the best location I could find at the time, yet they were far from ideal from the flying point of view, the ground being divided by fences while the area near our railway arch was covered with stumps of wood used for tethering goats and donkeys. Further out the surface was better, but the area was small, being bounded on one side by a fence, and on the other by the River Lea.

Our general procedure at Lea Marshes was to make an early start with our experiments. We used to be up at 4 a.m., when we gathered at our ' shed ' under the railway arches. We had boarded up the ends of two of them, but it was hardly an ideal workshop, for there were no windows and it was necessary to take down the shutters if we wanted light. The arch brick roof invariably leaked, as they usually do, the floor was muddy, and occasionally we were flooded out. How-

ever, as at Brooklands, we had a coke fire to cheer us up and toast bread, boil water, etc.

The machine would be wheeled out and pushed to a suitable corner of the ground, amid occasionally excited expressions, sometimes jeers and sometimes rude remarks of lookers-on. "What time are you going up, governor?" was a common remark. We then endeavoured to start up the engine, a task which usually took at least a quarter of an hour. When it was started and warmed I would give the signal: "Let go," and the machine then tore over the ground followed by my helpers carrying tools, pieces of timber, and other necessary appliances to cope with the repairs necessary after the almost inevitable 'crash.'

When the landing took place after a 'hop,' which might be anything from 10 to 120 yards, there was always a chance that a miracle might have occurred and the machine was still intact and undamaged. In such cases the process was repeated until the 'crash' did take place. The average programme will be better understood when I say that there used to be two weeks' work, a 50-yards' 'hop,' a 'crash,' and then the programme repeated all over again.

One day, whilst I was carrying out tests over the marshes, it appears that a young woman came down to the banks of the River Lea with the intention of committing suicide. But when she saw my machine another plan for self-destruction seems to have entered her head. She abandoned her idea of jumping into the river, and instead went back to her home and wrote me a letter, in which she urged me to let her take my place as pilot in the aeroplane, thus saving my life at the expense of hers. This was hardly a tribute to the safety or stability of my machine—poor as it was in those respects—but it conveys an idea of what people thought of airmen and their machines in those early days of flight. As mentioned previously, we were

looked upon as wild adventurers, but there were others who took a broader view and thought that our experiments might result in results which would bring advantage to humanity. Possibly in view of the way in which the aeroplane has been used for the object of destruction it might have been just as well if all our experiments in the early days had ended—in nothing. But it must not be, and I hope and believe that in the years to come the aeroplane will take its place without any reservations as being, like many other useful inventions, of great benefit to civilization.

When it came to me to reply to the young lady and her suggestion I found it no easy task. In the end I wrote suggesting that I would not like anyone except myself to fly my machine as it was so tricky, but that I was building another machine and perhaps I would then be able to let her fly it. I told her also that it would be a much easier machine to fly, so therefore she would have something to look forward to. I hope that my letter had the effect of distracting her morbid thoughts, but I heard nothing more from her.

Another and more serious problem cropped up when the local authorities began to take an unwelcome interest in my operations. It was even suggested that I disturbed the local 'tramps.' In their rules and regulations, it appeared, there was nothing to be found which permitted flying experiments on such a public place as the Lea Marshes. I was not warned that I was infringing the law, but instead a bailiff was put on my track. He had no easy task, for by this time I had grown so accustomed to early rising that he found me a most elusive person to catch. I was able, in consequence, to put in a good deal more testing work in the very early hours of the morning before he was able to secure my name and address and sufficient 'evidence' to begin police proceedings against me.

I never appeared in court, and for the reason that

air history had now moved to July 1909, when the whole world was thrilled very suddenly by the news of Blériot's epoch-making flight across the English Channel. This great French pioneer came afterwards to London, being the guest of honour at banquets and other functions. In such circumstances, it would have appeared ironical, to say the least of it, if a British pioneer had been placed in the dock, charged with the 'crime' of endeavouring to fly in his own aeroplane. It would have thrown into glaring relief the difference in the official attitude towards aviation as adopted by France and England, and might have done much to explain the success of experimenters in the former country. The local authorities in my own case, however, decided to drop the case to avoid making themselves appear ridiculous.

I do not wish to suggest that the authorities at Lea Marshes were peculiar or unique at that time in their dislike of flying. I believe that had I been in many other places I would have met with the same official attitude.

Following Blériot's flight across the English Channel there came the world's first flying meeting at Rheims, at which there were more than thirty aviators. The only British competitor being Mr. G. B. Cockburn. It was this meeting which gave added emphasis to the importance of Blériot's flight, for there was now assembled many of the most important machines in the new world of aviation. Each day saw some new record being broken and many valuable lessons were learned. As an indication of the position at that time I might mention that during the course of the meeting there were more than a hundred flights, eighty-seven of them exceeding 3 miles. There were seven flights over one hour in duration and three of these exceeded two hours and one even lasted over three hours.

To this meeting went town councillors from Black-

pool, and they returned determined that their resort should also have a pioneer air meeting. But, in effect, they were forestalled by Doncaster which held a meeting on 15–23 October, whilst the Blackpool meeting was held from 18–23 October. The Doncaster meeting was actually the first flying meeting to be held in Britain despite the fact that the Aero Club not only refused to recognize it, but actually banned it. The Aero Club had, as a matter of fact, not been at all anxious to have any meetings held in 1909, but thought that it would be better to make a start the following year.

At Doncaster, which I did not attend, there were a number of competitors including Cody who distinguished himself highly by making a fine cross-country flight of 47 miles in sixty-three minutes. The meeting was generally hampered by very bad weather conditions. It was at the end of this meeting that Cody became naturalized as a British citizen, and this enabled him to enter for certain prizes which were only open to Britishers.

The Blackpool meeting also suffered from bad weather. A number of famous foreign pilots were engaged to fly while I myself took my little 9 h.p. triplane there, and did my best to encourage it into the air. I could not help contrasting my own efforts to coax my machine into the air with the performance of some of the French competitors, for whilst I did try to do this many of their machines never even left their hangars.

A few 'straights' were the best I could accomplish in the air. My chief trouble being lack of sufficient power, my 9 h.p. engine comparing with the 50 h.p. engines in the foreign machines. Then the continued wet and damp had also ill-effects for my little machine as the yellow cotton-oiled paper, with which the wings were covered, tended to slacken, thus impairing

efficiency considerably. This yellow covering of my wings caused my machine to be referred to, jocularly, as 'The Yellow Peril' and 'The Yellow Terror.'

One of my early impressions of that first Blackpool meeting was the wonderful patience of the crowd. Wind and rain continued almost without ceasing. For hours there was nothing to see, all the machines being imprisoned in their sheds. It was during one of these inactive spells, when spectators had been waiting in vain even for a machine to be wheeled out of its shed, that one member of the crowd—who sounded like a miner—called out to a passing official : " Say, mister, when's t'interval ? "

Undoubtedly the flight of the meeting was that made by the late Hubert Latham in a very high wind. The crowd had been getting restive under the continued lack of flying and one day Latham decided that he would go up despite the bad weather conditions. He had his 'Antoinette' brought out of its shed and, despite the protests of all his friends, who declared that no one had yet flown under such gusty conditions, he mounted his machine and made a ten-minute flight in a wind which sometimes exceeded 40 miles an hour.

He had a certain amount of difficulty in leaving the ground, and when he had got into the air all the spectators watched with amazement his struggle with the elements. His machine swayed and tossed about in a most alarming manner and every second we expected to see a terrible disaster. Paulhan, who was also at the meeting with a 'Henri Farman' biplane, was running about wringing his hands in despair, and when at last Latham landed many of his fellow-countrymen were in a state of tears through their overwrought feelings.

Actually it was computed that Latham had, in the air, attained a speed of nearly 90 miles an hour when he had the wind behind him, but when he was flying

against the wind his speed was almost motionless. To-day such a flight would present no difficulties, but at that time it was considered astounding.

One day Mr. Hamilton Fyfe, who was describing the meeting for the *Daily Mail*, came over to have a chat with me. He suggested that it might be better perhaps if I were to work more on the lines of the French designers. I answered him by saying: "If you were to ask Henri Farman to try and build an aeroplane with my finances and with my 9 h.p. engine I think he would find it a bit of a problem."

What I was concerned about was not so much the immediate results I was obtaining as the knowledge that my experimental work was developing along the lines which I believed were more sound from an aerodynamical point of view than my French rivals. I was already convinced of the value of the tractor aeroplane, with engine and propeller in front, and with the pilot sitting in the fuselage behind the engine, although at that time, the most successful continental machines were pusher-type with engines and propellers placed behind their main planes. In this regard it was not long before the trend of design showed that the tractor type was becoming popular.

The final results of the Blackpool meeting were that Latham was awarded the first prize for the slowest circuit (about 2 miles) at a speed of 22 miles per hour. He was also given the first general merit prize of £300 for his 6-mile flight in the high wind. Paulhan got the second prize of £150 for a flight on his Farman biplane 'of nearly 16 miles in a wind varying from 15 to 23 miles an hour. Whilst Rougier, another French competitor, on his 'Voisin' machine, was given the third prize of £50 'for his high flight of nearly 800 feet.'

After the Blackpool meeting, and with winter coming on, I decided to build a third aeroplane, this time

abandoning the 9 h.p. 'J.A.P.' engine in favour of a 14 h.p. motor built by the same firm. How I was to finance this new venture I had not the slightest idea, as almost all my savings had now been spent. Up to 1909 I had carried on with whatever money I had managed to earn at sea and ashore, including the sale of some of my cycling prizes. My father had also been good enough to give or lend me a little. It was actually early in 1909 that my brother Humphrey—better known as 'H. V.'—appeared in the picture, but it was not until early in 1910 that sufficient finance could be found. I describe this side of our work more fully in a later chapter.

As one indication, however, of the financial stringency under which I had to work I will relate how, in the new machine which I now wished to build, I wanted to use a good deal of light-gauge steel tubing. With this end in view I went along to Great Eastern Street, London, to see what Brown Brothers could do for me. After examining my list, they told me that the tubing I required would cost me about £10. That settled the matter as far as I was concerned, for an expenditure of £10 was considerably greater than I could afford and much greater than I had anticipated. I retired as gracefully as I could. Then, converting my list into timber, I cycled to Wandsworth to a firm I had dealt with before and found I could obtain all my requirements in wood for a few shillings.

Being eager to get on with the building of my new machine, I remember cycling back to my workshop with long lengths of timber balanced on my shoulder. I was proud of this specially selected wood which I had acquired in this way, and the thought certainly never entered my head that a time would come—and not so many years ahead either—when a firm bearing my name would be buying timber for aeroplane construction not by the piece but by the ship-load, and

that approximately 15,000 lumbermen would be engaged in cutting down trees to be converted into Avro aircraft.

By this time I had changed the scene of my flying operations. I had left Lea Marshes and gone to Wembley Park. This area is so much transformed to-day that it is almost impossible to recognize any of the old landmarks with which I became so familiar.

Having decided that I must have the assistance of a draughtsman in working on my new machine, I put an advertisement in *The Engineer*, and secured the services of Mr. R. J. Parrott, who began a long association with A. V. Roe & Co., Ltd ; and whom I look upon as one of the most able men in the aircraft industry to-day.

I had been able, with help from my brother, to buy a more powerful engine. It was a 14 h.p. 'J.A.P.' in place of my old 9 h.p. of the same make. With this increased power I found that after starting off close to the base of the old tower on the hill at Wembley—it had been originally planned to be a super Eiffel Tower —I could fly round the park buildings and back to the hill from where I had ascended ; but the trees and the base of the tower prevented me from regaining my actual starting-point. To regain it I would reverse my machine and fly back again. But it happens often that 'pride comes before a fall.' Having made turns in the air to the right and left, I began to think that I had almost mastered the art of flying. Then one day I found my machine toppling over, and going out of control, in spite of the full warp which I employed to prevent it doing so. I found out afterwards that was due to my not making a proper use of the rudder, as I should have done, in conjunction with the lateral control. In these days a highly skilled instructor teaches the pupil how to deal with these and many other conditions, whereas in the early days of aviation one had to find out these things for oneself.

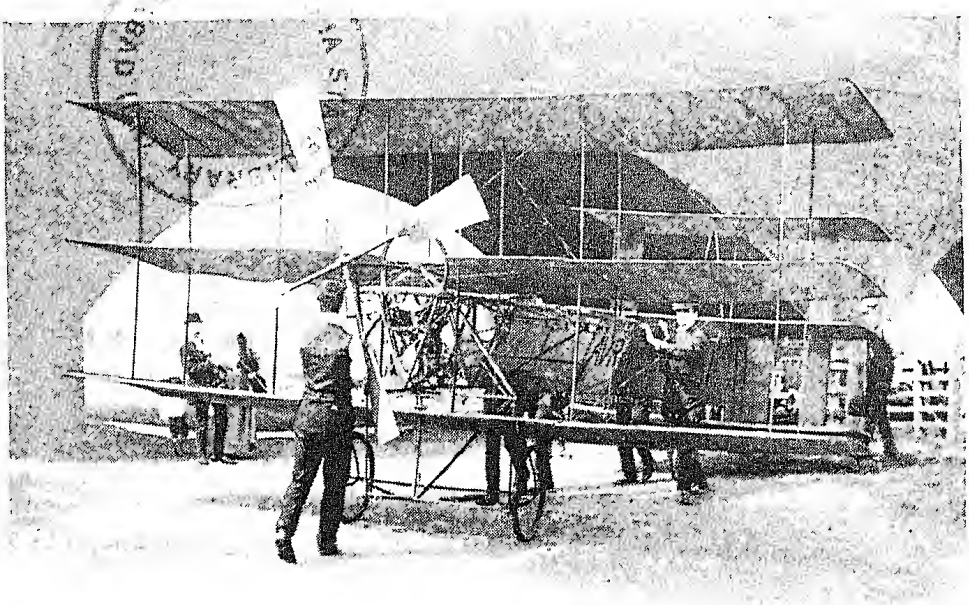
If there is not sufficient speed or thrust when warping or using the ailerons, it causes the deflected side to slow up and lose lift and that side drops. If, say, the left drops and the rudder is put over to the right, this makes the machine turn to the right and therefore increases its speed and consequently the lift of the left wing.

The machine on which I was now flying had several interesting features. The angle of the main planes and of the tail were both controllable and the main planes were warped for lateral control. Later I fixed the tail-plane and controlled the longitudinal path of the machine by varying the angle of the main planes alone. This method was revived recently in the *Pou de Ceil* or ' Sky Louse '—a French midget production.

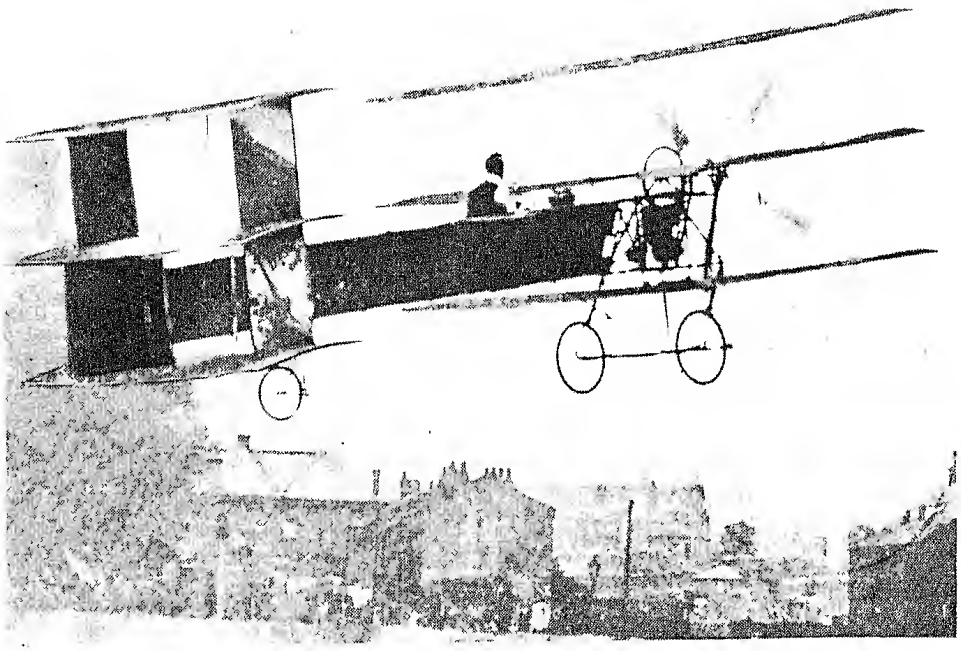
Actually the system of controlling both the main plane and tail has much to recommend it, as it would help to make slower landings while keeping horizontal. Recently Sir W. G. Armstrong-Whitworth, Ltd., took out a patent for the operation of the main planes of big aeroplanes in this way. It will be interesting to see if this idea is developed further.

I carried on with my experiments until the early part of 1910. Everything was going out, but nothing was coming in, and my financial position again reached a highly critical state. I had almost come to the conclusion that it would be impossible for me to carry on with my work, and that all my previous labours would be wasted and in vain.

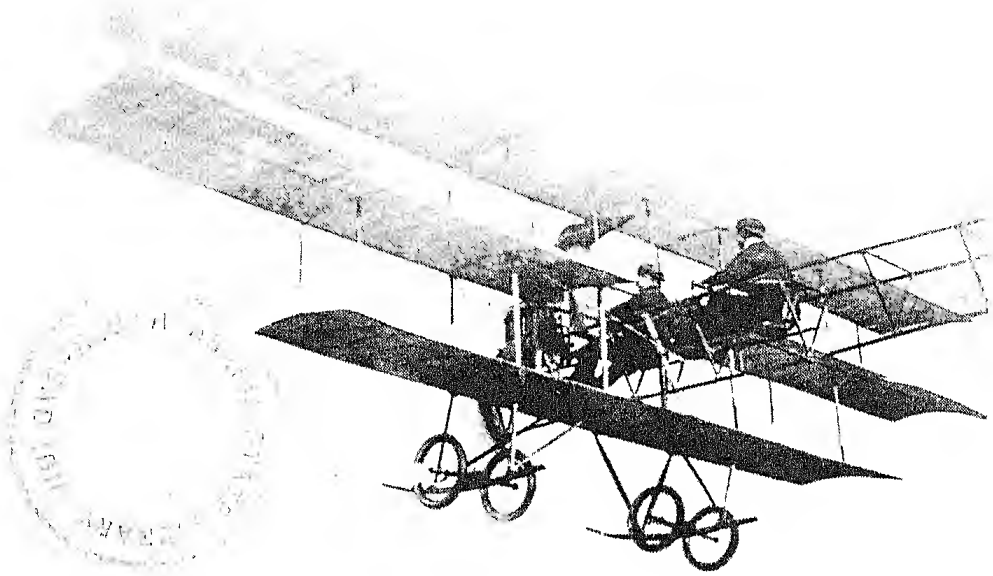
It was at this stage that my brother H. V. stepped definitely into the breach and saved the embryo ' Avro ' business from an early death. My father was rather doubtful about aviation becoming a practical proposition in my time, and thought I could not live to benefit by my pioneering labours, even though he had given me certain financial assistance. It was my mother who was my chief supporter, as she always had



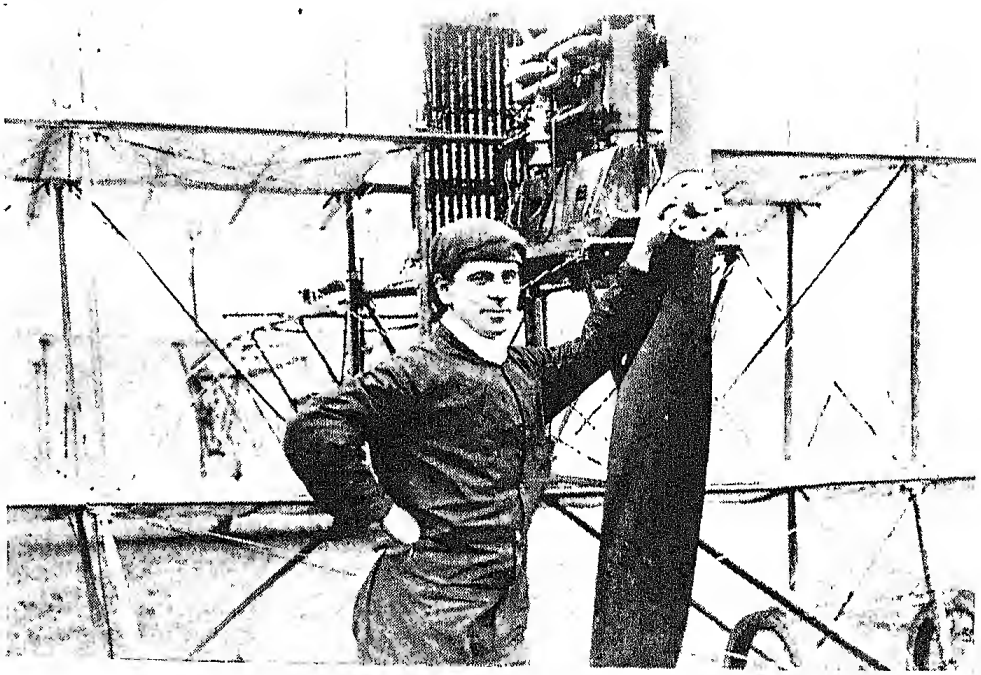
A. V-R. WITH HIS TRIPLANE AT LEA MARSHES



A. V-R. IN FLIGHT IN HIS 9 H.P. TRIPLANE AT LEA MARSHES IN 1909



A. V-R. (IN REAR SEAT) CARRYING A PASSENGER IN HIS 35 H.P. 'GREEN'-ENGINED TRIPLANE



A. V-R. AT BLACKPOOL, 1910, WITH HIS HURRIEDLY CONSTRUCTED 35 H.P. TRIPLANE

Flown in unfinished condition, fuselage not covered.

great faith in what I was doing. She used to urge my brother to help me as she considered him to be a good business man.

After finishing his education H. V. was commissioned to the Manchester Regiment. He served with his battalion in the Boer War and had gone through the siege of Ladysmith. After this, just as he was about to be promoted to Captain, he had abandoned his military career, and had come back from South Africa in February 1902. One of my mother's uncles who owned a firm of webbing manufacturers in Manchester, called Everard & Co., had just died. The two chief men in the business, the manager and traveller, started up in opposition. My brother tried to sell the business for the sake of the widow, but as no buyer came along he bought it himself. He made one of the workmen works manager and himself did the travelling and kept his books during the week-end.

By sheer hard work H. V. got this enterprise on its feet again, and he then had ideas for expansion. He looked out for a capable man to assist him and discovered Mr. John Lord, who became manager of Everard & Co. As a result of this my brother found that he had more free time, and as he was much interested in the stage to which I had brought my aeronautical labours he decided to come into active partnership with me. Later Mr. John Lord was to join our aeronautical work.

At that time the most successful single product of Everard & Co. was an article of men's wear sold under the proprietary name of 'Bullseye Braces.' Naturally, when people came to know that the 'Avro' machines were financed by H. V. Roe there came a stock joke that 'Avro' biplanes were kept up by Bullseye Braces—which was financially true.

As soon as my brother became associated with me we bought a 35 h.p. 'Green' aero-engine, and also a 35 h.p. 'J.A.P.,' and began building two new triplanes

at the Brownsfield Mills at Manchester—the home of the braces. While we were thus engaged the management at Brooklands underwent a change. Major (now Colonel) Lindsay Lloyd became the track manager. He realized the importance of flying, and had the foresight to convert the centre of the track into an aerodrome with some aeroplane sheds erected at the south end. This changed attitude at Brooklands enabled me to leave Wembley Park, which was not at all a suitable place, and take a shed at Brooklands. I was welcomed back to the place where I had undergone my early trials and where I had made my first flight from the track. And it was from this date that the history of the 'Avro' firm properly begins.

CHAPTER FIVE

BROOKLANDS DAYS

THE Brooklands to which I now returned was a vastly different place to what I had known before. There was as much encouragement now as there had been discouragement before. Major Lindsay Lloyd had gathered there a little band of pioneer aviators, and we formed a very happy community. I have heard it said of us that we were a society like the Early Christians, for we practised fellowship and the community of goods. Certainly everyone did their best to oblige each other—with the usual few exceptions, of course. When someone was short of some vital part for his machine he would search round the other sheds until he found someone who could oblige. One of the strangest things was the way many embryo flyers used to wander round getting the loan of other people's propellers and then try them in their own machines with the hope of getting better results. At that time proper scientific work on propellers had made very little headway, and such a person as a propeller maker did not exist. I think it was Mr. Dashwood Lang, who was at Brooklands at that time, who first specialized in this important part of the aeroplane, and became the first specialized British propeller manufacturer.

There were two special features of Brooklands in those days which I will always remember. They formed an odd contrast, for they were the historic 'Blue Bird' restaurant, and the sewage farm. I am

not sure which of these I spent the most time in. At the former forgathered most of those who were working at Brooklands, besides the enthusiasts who came down to see what we were doing. Few places can have seen such visions and dreams created. There used to be endless discussions and arguments over every kind of flying matter. The place was run by a Mrs. Billings and she catered very well for our requirements. The 'Blue Bird' was both our club and a place to which we could turn for a brief respite and a meal from our endless work in the sheds—when we could afford it.

There were times in the hot weather of the summer when we did have unpleasant distractions at this place, for it used to become infested with wasps. Perhaps it was the jam which attracted them, or it may have been that the wasps wished to escape from the nearby sewage farm, but whatever the original cause for their presence we had to use petrol sprays and proceed to demolish these flying pests ; jam jars partly filled with beer or water and jam caught many ; after which we were able to carry on with our teas, our discussion—and our jam.

The sewage farm was an entirely different proposition. It had a magnetic attraction to all of us, for it lay in one corner of the ground which had been laid out as an aerodrome. I doubt if there was any flier, at that time, who did not at some time or other and often on more than one occasion make personal acquaintance with this highly unpleasant spot. There were various theories as to why it should attract our machines, for clearly no one wished to land there of their own free will. It was even suggested that the air above this piece of ground had an effect upon the running of the engine. But I do know that it seemed to gape at us when we were in the slightest difficulty about where to land.

To-day I look back on those distant Brooklands days with pleasant memories. We lived in a constant state of exhilaration and thrills. There was the spirit of adventure which so frequently exists in a pioneer colony. There were tragedies, as there must be in new ventures, but there was also a great zest in life and an extraordinary feeling of hope and optimism. Since that time we have all gone our different ways. There are a few who have distinguished themselves and become leaders in the aircraft industry, many are dead, others still gave their contribution to the young industry and then left for some other form of work. No doubt these early efforts in all their directions played their part and had a value in furthering the science of flight.

In calling to mind a few memories of persons who were at Brooklands in those days I realize that I must be somewhat sketchy.

There was the late Gordon Bell who was most prolific in his choice of machines on which he flew. I think at one time or another he must have flown on all the aeroplanes there were at Brooklands. He was very short-sighted and wore glasses which he was frequently losing, especially when he happened to be getting in or out of his machine. On one occasion he had a terrible accident in which his passenger was killed and he escaped with a broken skull. He recovered and went on flying without any apparent loss of nerve. He had a peculiar manner with a drawl and stammer in his speech. For some reason he used to amuse himself by coming round to our sheds, where he made belittling and scathing remarks about our machines. I used to call him various names and on more than one occasion we nearly came to blows. He was a most reckless flier and certainly did not seem fond of anything in the nature of hard work.

Another early flier who also suffered from very bad sight was E. V. Sassoon, a wealthy man, who was

famous, or perhaps I should say notorious, for his astounding landings. Perhaps it was due to his bad eyesight, but he must have made more bad landings and smashed more under-carriages than any other flier there at that time. He walks with a limp as a result of breaking a leg badly.

We had a lady flier at Brooklands. I asked her once for the loan of a small tool for making little wire rings for holding pins in position on the 'Gnome' engine. When I returned it to her she asked me how many rings I had made. I said a dozen. She then said she charged a penny a ring and demanded one shilling. I complained, as I thought it rather grasping to make such a charge. However, she insisted very determinedly that she should be paid. Louis Noel, who was a late employe of mine and now was working for her, was standing by looking rather uncomfortable. He produced a shilling and offered it to the lady, who was by now in a temper. This only infuriated her more and she turned round on me shouting: "You allow one of your late employes to stand there and pay your debts, and call yourself a gentleman." I had, of course, not the slightest intention of letting Noel pay my 'debts,' but I did feel the lady was hardly conforming to the general spirit of Brooklands at that time.

Another amusing experience I had was in connection with the late Lieut. J. C. Porte who was head of the British Deperdussin Company. He had an old 'Deperdussin' which he used for teaching pupils, but although it would taxi about safely, yet it could not get into the air. I told Porte that I was of the opinion that if he were to fit a more efficient propeller that it could be made to fly. I designed a suitable propeller of a large diameter, narrow blades, and with a finer pitch than the one he was using. Then I instructed our carpenter to make one, giving him the various sections and angles. If I remember correctly it was Captain

J. B. Fulton, R.F.A., who first tried this machine with our propeller, and he had already done a certain amount of taxi-ing on it. However, when he opened the throttle, to everyone's surprise the machine leapt off the ground ; apparently not being prepared for a flight, he made a rather bad landing, breaking the propeller. I sent in a bill for £5 for it, but could not persuade Porte to pay, as he considered it was on trial at our risk. In view of the fact that the propeller had done what I promised it would do, I certainly considered it should be paid for.

I heard that the carpenter who had made the propeller went round proudly telling people that he had designed it and had thus made the taxi-ing 'Deperdussin' fly when others had not been able to do this. So I asked him why he had made such a statement, adding that I presumed he had carried out my instructions as regards the various sections and angles. He replied he had made the propeller according to my instructions, but added, enigmatically, that what I called a 3-foot pitch he did not. This certainly seemed a strange reason for his claim to have designed the propeller.

Captain Fulton took a prominent part in the formation of the Air Battalion in March 1911, which was an early step towards the establishment of the R.A.F., when a special Army Order was issued by the War Office giving particulars of the new Air Battalion which was to supersede the existing Balloon School at Farnborough. Captain Fulton had a delightful personality and his death, as a colonel, was much felt by his many friends in the early days.

One of the experimenters adopted a rather pretty daughter and rented a small cottage on the aerodrome. For some reason or other the rowdy element one evening considered it rather a joke to disturb him. He got very wild over this and fired a revolver at his

invisible foes whilst they threw things through a window. I think it was on that occasion that they ploughed through some of the shed doors with the power-driven roller, but they had to pay for the damage done.

I will return now to discuss my own activities in flying. As far as my own machines were concerned the two 35 h.p. triplanes were eventually completed. We started off with a number of 'crashes,' but at length I got the 'Green'-engined machine to take to the air satisfactorily. The chief cause of the 'crashes' was due to the weight being too far back or insufficient angle on the tail plane, which allowed the machine to climb. When I found out this error the sooner I switched off the engine the better, for every second's delay meant a greater height to fall or pancake from.

I well remember one machine which puzzled me very much. On two occasions I had endeavoured to get it to fly, but before I had time to find out what the trouble was it simply turned over and 'crashed.' I had no inclination to let anyone else try the machine because I thought they would make an even worse hash of it than I had done. However, on the third effort it seemed much more stable and climbed nicely. I pushed the 'joystick' forward to make the machine fly level, but it persisted in climbing. I thought possibly the control wires had become crossed so I pulled the stick back, but the machine began to climb more steeply than ever, so I immediately pushed the 'joystick' forward, switched off, and pancaked down. Of course, it smashed the machine rather badly, but we had no more trouble from this cause until I went to the United States in November 1910.

Our other machine, driven by a 35 h.p. 'J.A.P.' engine, was a lovely triplane to fly, but the engine lost power after about ten minutes in the air. The cylinder wall had holes drilled in it to help out the

exhaust, and this meant that after about five minutes' flying my goggles got so covered with oil I had to take them off and literally blink my way for the rest of the time I was in the air. My appearance when I came to earth again can be imagined, and it took me longer to get myself clean than I had spent in the air. The trouble with this engine was that it used to overheat, and my best flight on this machine was just over twenty minutes.

At that time at Brooklands it used, indeed, to be considered by some experimenters quite a remarkable feat if their machine was able to leave the ground at all, and many people spent hours taxi-ing their machines over the ground, ending up usually with their under-carriage suddenly collapsing, and sometimes the aeroplane would roll up into a bundle of wire and wood. Many of the accidents looked highly dangerous, but it was strange how well those on board managed to escape usually with nothing worse than cuts and bruises. When some new machine did actually get into the air, then it provided a theme for discussion. There were, of course, a few strange machines of astounding design which would usually remain on exhibition in their sheds. Perhaps it was just as well that they did so for in 1910 there were about forty sheds at Brooklands and the air, at times, became almost overcrowded.

As an instance of the progress we were making in the art of flying I call to mind that on Whit-Monday, 1910, there was held at the course an aeroplane handicap race. The race was over a distance of 12 miles, and there were fourteen entrants who were divided into two heats. Amongst these fourteen entries there were represented no fewer than ten different types of machines, including one of our make.

It may possibly be of interest to modern-day readers to be told that up to the end of 1909 there were less

than a dozen pilots in the whole world who had made a flight exceeding an hour's duration. The flight of the year was undoubtedly that made by M. Blériot when he crossed the Straits of Dover in his monoplane, thus winning the prize of £1000 given by the *Daily Mail*. During 1910 considerable progress was recorded, for there were three hundred and fifty flights made which exceeded one hour in duration. Of this total, seventy-six exceeded two hours, twenty exceeded three hours, three exceeded four hours, two exceeded five hours, and one exceeded six hours. Major C. C. Turner has made an estimate that in 1910 from 80,000 to 90,000 miles were flown in the whole world, and that there was one fatality for every 3600 miles flown. Such a proportion would obviously be disastrous with modern flying mileages.

In the autumn of this year a flying meeting had been arranged to take place once more at Blackpool. It was organized by the Lancashire Aero Club, and it opened on July 28. There were a number of excellent prizes being offered, and I felt that we had a good chance of winning some of them. With this end in view we decided to enter both our machines.

A few days before the meeting was due to commence we loaded the two machines at Weybridge station along with spares, trunks, cycles—in fact all our worldly goods. As ill-luck would have it the engine was puffing up an incline near Wigan when some sparks from it blew on to the tarpaulins covering our machines, and reduced both of them with all our other goods to ashes. There were other aeroplanes on the same train, but they escaped catching fire.

I arrived at Blackpool on the Wednesday evening before the meeting was due to open and found our mechanic, Pixton, in tears. I quickly learned the cause.

I do not think I have ever been so stunned or disappointed in all my life. It was, indeed, a calamitous

tragedy for us. It took me some time before I could make my mind act, for I had pinned my hopes on winning some of the prizes which would have been so useful in enabling us to carry on with our experiments. If we were to compete it was essential to get another machine ready. I left immediately for Manchester, arriving there on Thursday morning. There was exactly four days before the Blackpool meeting was to open on the following Monday.

Something had to be done. In our workshop we had various parts left over from the construction of the two machines which had just been destroyed. We set to, working day and night, with the result that by Saturday midnight we had completed a new triplane of a sort. Fortunately for us in those days there was none of that meticulous Air Ministry inspection which exists to-day. If there had been this new machine of ours would have been quickly condemned as being highly dangerous. We had no time to cover the fuselage, but I had endeavoured to counter-balance the nose heaviness by pivoting the tail farther back on its chord. There was obviously no time to test it before the meeting started.

We got the aeroplane up to Blackpool on Sunday afternoon, and I told the mechanics to start work on it at 6 a.m. the next morning. However, after I had had some tea I commenced erecting the machine myself and became so engrossed on the job that I had it nearly all together by the time my mechanics arrived the next morning. Of course, there were lots of minor details requiring attention. The 'Green' engine arrived about nine o'clock, and by noon we were ready to make the first trial flight.

I might mention that I never received a penny by way of compensation from the railway, and as the point had never been contested as to the liability or otherwise of a railway company for damage caused

through engine sparks I certainly did not feel wealthy enough to fight the question on my own account.

Meanwhile Grahame-White had arrived late the previous day, and had collected a prize of £100 by flying for several minutes round the course.

As it was Bank Holiday there was a very big crowd present when at two o'clock I started up the engine, and taxied forth. It was not long before accidents started to take place for two of my tyres burst in rapid succession, with the result that I was compelled to take off by running the machine on the rims. The engine also roared in fits and starts, and instead of my improvements in the tail preventing the nose heaviness, it had just the opposite effect, due to the alteration of the plane section, and I had to press the 'joystick' forward with my knees every few minutes so as to relieve my arms and whilst doing so I had to neglect the rudder. The result was the machine became practically uncontrollable and I doubted whether I would ever get her back into the aerodrome, for I had been blown right over the heads of the crowd and beyond the confines of the ground. The people were cheering like mad beneath me, for they knew I was a native of the district, but they certainly did not realize the danger they were in if I should be obliged to make a forced landing. I do not know who got the biggest thrill—the crowd or myself—but I think it must have been myself. As it was I managed on this trip to fly round the course three times and back safely into the aerodrome. Altogether I had three smashes at Blackpool, but as I was given a consolation prize of £75 we had something for our trouble after all.

As had happened the year before the weather was generally bad throughout most of the meeting. There were only eleven entrants at this meeting, and these included Grahame-White, Chavez, A. Drexel, Cecil Grace, W. McArdle, and Robert Loraine (the famous

actor). Chavez on a 'Blériot' machine succeeded in beating the world's height record at 5887 feet. There was again a remarkable flight in a strong wind which, although it did not attract the interest that Latham's had the year before, was equally meritorious. It was made by McArdle flying a 'Blériot.' When he went up the wind exceeded fifty miles an hour and at times he seemed to be actually driven back by the force of the gale.

During the first week at this display prizes amounting to £300 were awarded each day. This sum was divided into a general merit prize of £100, an altitude prize of £50, and two prizes of £100 and £50 respectively for the greatest aggregate distance flown. There were, in addition, special prizes awarded over the course of the whole meeting.

Grahame-White was fortunate as during the second week of the meeting he was engaged at a fee of £2,000 to give exhibition flights.

Present at this meeting was Mr. J. V. Martin, a well-known pioneer flier from the United States, and he arranged for Grahame-White and myself to go over to his country for a flying meeting which had been arranged to take place shortly after the conclusion of the Blackpool meeting. We had already sold a triplane to Harvard Aeronautical Society, and as it had arrived in America and had not yet been flown it was decided that I should fly both this machine and likewise my Blackpool mount.

Before leaving Blackpool I contrived to get quietly married at Trinity Church, South Shore, the only Press representative being the *Daily Mirror* photographer who had discovered the scene of the ceremony. I had been shadowed in the morning but had managed to evade the other pursuers.

There was no time for any long honeymoon as on 23 August, three days later, I had to leave Mrs. Roe and embark on the *Cymric* for Boston. This was my third visit to the United States.

CHAPTER SIX

MILITARY TRIALS

ON our arrival at Boston we were received by J. V. Martin, Carl Sylvester, Louis R. Spear, and J. C. Barr—all of the Harvard-Boston reception committee. They met us at the harbour and we were driven to our hotel. It was a very expensive one and at the end of a week I moved to another hotel which had been recommended for its comfort and reasonable rates. The Americans looked after us very well and showed us all that great hospitality for which they are famous.

During the meeting I had three 'crashes,' the first two were of a more or less minor nature, but the third was a more serious one that resulted in my having to go to hospital.

The last accident took place at about four-thirty in the afternoon of the last day of the meeting. I took my machine off the ground without incident and flew straight down the aerodrome which was situated at Atlantic Field. Climbing over some trees I was unable to overcome the effect of the up-current on one side as the machine was practically flying on the stall. It was the old trouble again; engine was not giving sufficient power. However, I stalled and nose-dived. The machine became a tangled mess, and the accident looked a serious one, for I was covered with blood. A number of people came rushing up and I was laid on a bench, where I heard someone ask if any of my bones were broken. So I moved my hands, arms, and legs quickly and thus assured myself and them that I was all right. But the management insisted that I

should go to hospital for a couple of days. The doctor put in three stitches in a head wound which I had received, but I was soon fit again. A few days later Grahame-White and I were motored to President Taft's country home which was about thirty miles from Boston. He received us very kindly and showed a great interest in matters of aviation, asking us many questions about our machines and experiences, and also questioned us on our opinions about the future of flying, our interview lasting about half an hour.

During the whole of my stay at Boston we had a most enjoyable time and all our spare moments were occupied in trying to cope with the many social activities which were offered to us. We were invited to parties at clubs, to theatres and dinners. It was rather thrilling for me after the more simple life to which I had been accustomed.

One feature which rather amused me was the way in which any odd remarks of ours were adapted to publicity purposes, and I found I had to be most careful what views I expressed, as even the most casual remarks provided top-line copy for the newspapers. On one occasion I happened to be passing a theatre where a few nights before we had been present to watch the performance. As a result the management had now got placards outside announcing our views on the play which was being performed. Grahame-White had apparently said : " I say, old fellow, what a splendid show ! " whilst my own eulogium had been the slightly milder one : " It's a jolly good play."

Grahame-White had taken a 'Farman' and a 'Blériot' to the Boston Meeting, and he was easily the most successful competitor, winning, in all, some £6420. He was a most popular figure and caused a great sensation by making a flying visit on the President. He flew his machine, landing it in Executive Avenue in Washington ; then he called on President Taft

at the White House, returned to his machine and flew away again. At the time this sensational form of making a visit caused great excitement in the American Press.

Following the Boston Meeting Grahame-White competed in the second international speed race for the Gordon-Bennett Trophy at Minneola Flying Ground near New York. For this event he had imported a special 100 h.p. 'Blériot' monoplane and he covered the hundred kilometres, which was the distance of the race at that time, at a speed of just over 60 miles an hour. He also won a prize for being the first person to fly round the Statue of Liberty. In recognition of his achievements in the United States Grahame-White on his return to England was presented, by the late Lord Roberts, with gold medals from the Royal Aero Club and the British Air League.

After the Boston Meeting I returned to England and resumed my designing and experimental work at Brooklands Aerodrome, all constructional work being carried out at our works in Manchester. I had by this time come to the conclusion that it was not worth while proceeding further with triplanes, for although there were a number of advantages obtained in utilizing the inertia of the air by the employment of a long entering edge and a high aspect ratio, yet there were aero-dynamical and constructional disadvantages which tended to outweigh the advantages.

The next machine we built was a biplane, which was more or less on the lines of the triplane, but as I was dissatisfied with it I designed a much cleaner machine on which was placed an eight-cylinder 'E.N.V.' engine. In this machine the lower wings were attached to the fuselage, a method which has now become general practice. This machine was followed by the 50 h.p. 'Gnome Avro,' being a very nice machine with delightfully clean lines which were greatly admired.

Up to this period the War Office had treated the efforts of British aeroplane constructors as being beneath their notice. I well remember about this time going to the House of Commons, with a few other pioneer aircraft constructors, with the object of meeting the Secretary of State for War and placing before him our views with reference to some support of our industry. We were received by Mr. Haldane, who was Secretary of State for War at that time, and after we had placed our case before him we were replied to by Colonel F. E. Seely (now Lord Mottistone), his secretary, who spoke on his behalf, saying: "Gentlemen, much as we would like to help you by placing orders, we regret we cannot do this, as we are trustees of the public purse, and we do not consider that aeroplanes will be of any possible use for war purposes." This historic statement may appear incredible to-day, but at that time it well exemplified the general attitude of British official circles towards the infant aviation industry.

When the War Office did eventually decide to make purchases of aeroplanes, true to that stupid British prejudice which has cost the country millions of pounds and countless lives, they purchased French machines. Major C. C. Turner wrote at that time in the *Observer*: 'I fear that few people realize what an exceedingly good machine the "Avro" is. If it had been a French production, the French Government would have ordered scores of the type, and it is highly probable, in that case, the British Government would have patronized it. What Mr. Roe suffers from, no doubt, is the fact that he was the first Englishman to achieve flight in this country, and his early struggles are remembered and are always coupled with his name, whilst the continual advance he has made in design during the last few years, culminating in the present type, is ignored.'

However, at last the War Office asked us to quote for

two 'Gnome Avros.' With the hopes of getting the order we quoted an absurdly low price, but even so we were asked to reduce it still further in consideration of the order being increased to three machines. The first of these machines was sent to the Royal Aircraft Factory (now Royal Aircraft Establishment) for a test to destruction. I was allowed to witness this test to destruction of our machine, and I shall never forget an official looking most critically at one of the pins which held an interplane strut in position.

"This pin is not strong enough," he told me.

I assured him there was a good factor of safety, but he replied in a most superior tone: "Yes, that might be so when the pin is new, but after the machine has been in use the factor of safety would be reduced."

"But we have had no trouble caused through wear," I answered.

"But your machines have done no flying," was his final crushing reply.

However, the tests proved very satisfactory, and it was found quite unnecessary to increase the size of the pins even after they had given many years' service.

I recall this particular incident in order to give an illustration of the official attitude which then existed towards those who dared to build and fly machines built by private enterprise. Aviation was still very young in those days, possibly those who were employed by the Government, with their much greater resources, regarded with some scorn the efforts of those who were struggling along on their own limited finances. When they did see a promising-looking machine they apparently could not believe it was better than their own product and were visibly surprised when it proved to be. An attempt to build an improved model of such a machine generally resulted in a costly machine which did not compare favourably with the outside rival. But those days have gone long

ago, and sometimes I meet with great pleasure the cheery people who were responsible for the management of Farnborough during that period, and there is not the slightest intention on my part to cast any slur or reflection on them. It is possible if we had been in their place we would have had just the same outlook. They were simply part of an official system which, as has been proved so often, cannot really compete effectively with competitive private enterprise.

The two remaining 50 h.p. 'Gnome Avros' became very popular, and further orders were given for this type in due course. Their type number was 501 and 500; the 500-type machine being those which were fitted with 'E.N.V.' engines, but were otherwise similar.

At about this time the War Office announced their intention of holding an aeroplane competition which was to take place towards the end of 1912 on Salisbury Plain. This competition was to be open to the whole world, but there was one section which was reserved exclusively for British-made machines. In the interval before the Trials were to take place the War Office decided that they would purchase no British machines at all, but rather illogically this same restriction did not apply to French machines, and some of the latter were indeed purchased. This strange action was a very serious blow to a sorely harassed industry. It almost seemed as though the Government would go to any extreme to avoid buying British machines. It is quite certain that in some cases, at least, their French purchases were of machines which were definitely inferior to those being produced in England. If at the Trials the entries had been restricted solely to British machines we would not have minded so much, but all the biggest prizes were being offered in the International Division, and only fairly small sums offered in the British Division.

About the same time the French Government instituted a similar kind of competition, but in their case entries were restricted entirely to aeroplanes of French manufacture throughout. The French clearly believed in supporting and building up their own aeroplane industry whilst the British manufacturers were assailed by blow after blow and the young industry was in a truly appalling state of neglect. As a result affairs got into a vicious circle. The British Government claimed that they did not feel they could buy British machines because they were not as good as the French ones. They declared they must have the best military aeroplanes and any sentiments about their being British-made could not enter into the matter. Yet their very policy was against us for we suffered from a continual lack of capital, simply because we had no orders or even promise of them. In the meantime the French got the credit of having the best machines for there was, as a result of French Government support, great activity in their aeroplane factories. They certainly had no difficulty in getting as much capital as they might require to carry out further experiments. It is obvious that in engineering and scientific work money is absolutely essential if results are to be obtained. It does happen occasionally —it happened in my own case—that experimental work must perforce be carried out on meagre means, but it is absurd to think that these same results would not be achieved far more quickly if sufficient money had been available. A great many valuable inventions which would greatly benefit humanity have been held up or even completely disappeared because of lack of funds. The British unfortunately invariably regard the inventor as they do the poet as being someone who is a little odd, deserving perhaps of charity, but hardly of support on his own merits. Actually in the case of aeroplanes in the period in question, they were

in every way as good as the French, in fact better, much as one dislikes to blow one's own trumpet. We were simply starved of opportunity to show what we could do.

Our firm was anxious to enter for this competition and we wished to make an all-British effort. With this end in view I designed an enclosed biplane to take a 60 h.p. 'Green' engine. It was not the first enclosed machine we had built, for earlier in the year we had built an enclosed monoplane of my design on which Lieutenant Parke, R.N., made a number of flights. This was the first totally enclosed aeroplane in the world to fly.

It was unfortunate that we did not enter our 50 h.p. 'Gnome Avro' in the Military Trials for in that case I am convinced we should have won the chief prizes. As it was we entered the enclosed 'Avro' biplane and we arranged for Lieutenant Parke to be its pilot.

When the Trials opened there were twenty machines on the ground—monoplanes being in the majority—but out of these only a dozen made any attempt to carry out the tests which were laid down.

The entries were :

MONOPLANES

Aeroplane.	*Engine.*	*Pilot.*
Bristol (B)	Gnome (F)	J. Valentine (B)
Bristol (B)	Gnome (F)	H. R. Busteed (B)
Aerial Wheel (B)	N.E.C. (B)	
Pigot (B)	Anzani (F)	Parr (B)
Handley Page (B)	Gnome (F)	E. Petre (B)
Martin-Handasyde (B)	Chenu (F)	C. Gordon Bell (B)
Vickers (B)	Viale (F)	Macdonald (B)
Mersey (B)	Isaacson (B)	R. C. Fenwick (B)
Deperdussin (B)	Anzani (F)	Lieut. J. C. Porte (B)
Deperdussin (B)	Gnome (F)	M. Prevost (F)
Deperdussin (F)	Gnome (F)	J. Vedrines (F)
Hanriot (F)	Gnome (F)	S. V. Sippe (B)

Aeroplane.	*Engine.*	*Pilot.*
Hanriot (F)	Gnome (F)	Bielovucie (Peruvian)
Blériot (F)	Gnome (F)	
Blériot (F)	Gnome (F)	Perreyon (F)

BIPLANES

Aeroplane.	*Engine.*	*Pilot.*
Avro (B)	Green (B)	Lieut. Parke (B)
Coventry Ord. (B)	Gnome (F)	
Coventry Ord. (B)	Chenu (F)	T. O. M. Sopwith (B)
Bristol (B)	Daimler (German)	Gordon England (B)
Bristol (B)	Gnome (F)	H. Pixton (B)
Flanders (B)	A.B.C. (B)	F. P. Raynham (B)
Cody (B)	Daimler (American)	S. F. Cody (B)
Breguet (B)	Salmson (F)	Moineau (F)
Farman (F)	Renault (F)	P. Verrier (F)

B=British.
F=French.

Some of the entries never appeared at the Trials. The preponderance of 'Gnome' engines will be noted for during the early years of flying this motor played a highly important part in its development. Many of the machines which were on the ground at the date of starting had only just been completed in time, and had not undergone any flying tests. Perhaps the most freakish machine of all was the 'Aerial Wheel'; it had enormous landing-wheels, but it never flew.

The Trials proved to be an eye-opener to most people and they demonstrated most conclusively the progress which was being made with flying. Despite the bad weather tests were carried out which had been hardly considered possible previously. It was the first occasion, too, in which proper scientific records were made of the capabilities and performances of various machines. Perhaps the greatest surprise of

all was the demonstration of the wind-flying qualities displayed by aeroplanes. Previously, except on special occasions, aeroplane pilots used to consider carefully the climatic conditions before they ventured forth, but at the Trials machines were seen out flying daily in quite high winds.

Another surprise which showed itself at the start of the Trials was in the climbing test. It was not expected that many of the machines would be able to carry out the requirements laid down, but actually the majority of machines which flew had no difficulty in performing the minimum tests required. In the French Trials, which had been held previous to the British Trials, the French machines, although they had more powerful engines and carried smaller loads, had not been able to climb in any case at a rate of as much as 200 feet per minute. In the British Trials this rate was considerably exceeded, the Cody biplane, for instance, attaining 1000 feet in only three and a half minutes.

One of the tests which each machine had to go through was speed of assembly. Our machine, if I remember rightly, won this for we were able to assemble the 'Avro' in fourteen and a half minutes. Some machines took hours.

Early in the Trials, Parke, when alighting on some rough ground with a following wind, turned a number of somersaults, consequently the machine was badly smashed. Parke, fortunately, was unscratched as he was strapped in, and when he emerged from the wreckage he stood and waved his arms so that the spectators were greatly relieved, as it almost seemed that he must have been killed. There was one death at the Trials when Mr. R. C. Fenwick was killed through his machine collapsing whilst in the air.

The weather was so bad at times that the Trials were often held up. This gave us time to send the wreckage to our Manchester works. Mr. Parrott soon had it

repaired and returned to us. The machine put up a very good performance afterwards, and, at times, looked as if it might win the competition. After completing the duration flight Parke became rather frisky, diving his machine steeply, and got into a spinning nose-dive, falling some 2000 feet. After trying everything he could think of, he managed to pull her out when very near to the ground. He was the first aviator who had ever got out of a spiral nose-dive which previously had always ended in fatal results.

Parke sometimes used to smoke a large calabash pipe whilst flying this enclosed machine, and my brother, 'H. V.,' took a typewriter up in the aeroplane during the Trials, being the first person to type in the air.

The results of the Trials were rather astonishing, for S. F. Cody eventually won the Trials both in the International and British divisions. His success was well-deserved for he was a lonely figure, working on his own account and was not supported by any firm or organization. His methods were severely practical, and the design and construction of his machine was the result of pure experience. His winning machine possessed a good range of speed—between 72 and 48 miles an hour. It also had great strength of construction which resulted in its being dubbed the 'Flying Cathedral,' and it compared favourably with many of the much lighter-built machines. However, I did not care for its general design.

The final results were :

INTERNATIONAL DIVISION

First Prize—£4000, Cody biplane, 'Austro-Daimler' engine.

Second Prize—£2000, Deperdussin monoplane.

BRITISH DIVISION

First Prize—£1000, Cody biplane, 'Austro-Daimler' engine.

Second Prize—There were two of these, but they were not awarded.

Three Third Prizes of £500 each were awarded to the British Deperdussin monoplane with 'Gnome' engine, and to the two Bristol monoplanes with 'Gnome' engines.

Six machines were awarded £100 each, namely, two Hanriot monoplanes, two Blériot monoplanes, one Maurice Farman biplane, and one Avro biplane.

Although Cody had won the Trials, his machine was not adopted for service, and only two were ordered by the Government.

It was, I think, unfortunate that the authorities decided to withhold some of the prize money. Even though they may have had sufficient excuse, yet the fact remains that every penny awarded to the young industry would have been a great help. It was a false economy to deprive us of the £2000; seeing that this money had been set aside for the Trials it might very well have been awarded. The Government officials were very surprised that British machines put up such a good showing in competition with the French machines which had been so much lauded. It rather disposed of the astounding indiscretion which Colonel Seely had perpetrated when making a Ministerial statement in Parliament in March 1912, when he declared that the War Office could not buy so many British aeroplanes as they could wish because the *first essential was efficiency and safety.*

It is true that the Minister was advised by a Technical Committee, yet he expressed their views in a tactless way which cast a great slur upon British constructors. French manufacturers with whom I spoke were astounded at the statement made by Colonel Seely. They knew, as well as we did, that his charges were not supportable by actual facts, but, in practice, they

certainly reaped many benefits for purchasers of machines, whether they were private or military, naturally thought that French machines must be the best.

During the long waits which took place at the Trials we all had ample time to argue and discuss every branch of flying. I remember one day we were sitting in a shed talking of our past efforts, when Parke said to Cody: "You can talk when you can build a machine like the 'Avro,' to carry two heavy people such as Pixton and May (Fred May of the Green Engine Co.) with a 35 h.p. 'Green' engine." Cody replied to this, speaking in his deep Buffalo Bill voice: "Well! Well! I don't mind. I'm the man who has copied nobody." Parke replied quickly, adopting Cody's tone of speech: "Yes! Yes! and you are the man nobody wants to copy."

However, if anybody wanted to copy him or not, his work was of great merit, and his death was a big blow to British aviation.

I will again revert to our own machine by quoting Major C. C. Turner, who wrote: 'In the biplane class the "Avro" had little to fear by comparison with any other. The table of results is unfair to the "Avro" in one respect—its climb is given as 9 mins. 30 secs. for the first 1000 feet of its climb. Apparently it must have struck a bad patch, for the second 1000 feet were climbed in less than three minutes. The glide of this machine was remarkably good, being 1 in 6·5. Its range or radius of action was second only to that of Cody. It carried petrol for six hours' flying.'

On one occasion Raynham, who had close connections with our firm although he was flying another make of machine at the Trials, went off in his car to get something or other at the small village of Amesbury which was not far distant. As he drove his mind must have been on other things, for after he had travelled more than 30 miles he suddenly realized that he had

gone far beyond his real destination. Actually he had taken a wrong turning and when he had pulled himself together he found that he was not far from Weybridge, where he had his home, so he just carried on, leaving us at the aerodrome distinctly worried by his non-appearance. The next day he did return and relieved us considerably.

Most of us have no doubt had a somewhat similar experience. Raynham having passed the corner when his mind was occupied evidently thought he was on a return journey, until he began to think what he was going back for.

It reminds me of a case of my own. I have been visiting the Patent Office, London, for nearly fifty years, and before the War I generally used to cycle there leaving my machine under some steps in a Chancery Lane office building. One day on returning for my cycle I found it had gone, so I said to myself—that's that—and went off to Gamages, via, I believe it is called, Staple Inn Walk, to see about buying another machine, when to my surprise I saw my cycle leaning against some railings. Then I remembered I had left it there instead of the usual place, having approached the Patent Office from that direction.

After the conclusion of the Trials Raynham, on our enclosed 'Avro,' beat the existing duration record for all-British machines when he made a 7½-hour non-stop flight. Yet this flight was soon beaten by a machine against whose chances of doing so one could doubtless have obtained the most incredible odds. This machine was Sopwith's rebuilt American Wright fitted with an 'A.B.C.' engine, designed by that clever designer, Mr. Granville Bradshaw.

As the competition was for all-British machines we felt that the entry of this machine was hardly fair and that it should not have been permitted. I believe that this engine had never previously made a non-stop

flight of more than ten minutes' duration, so that when Hawker started off with 8 hours' supply of petrol on board it seemed not only that he was an extreme optimist, but also that his chances of success seemed very slender and remote. However, hour after hour he flew round the neighbourhood of Brooklands until at last we saw our 7½ hours' duration record broken. I forget the exact margin by which it was exceeded. It may have been 15 minutes or even 30, but I do remember that this machine never made another performance, for when it was brought out the next time the engine broke down soon after starting, to such effect that it was never run again. Nevertheless, this engine did have many excellent features, and as a first attempt, what it had accomplished was both exceptional and a very creditable effort.

The conclusion of the Trials did not mean that the British aircraft industry became satisfied with Government action and policy. There was incessant criticism of the lack of support which was given to us and one of our chief causes of annoyance was the policy adopted by the Royal Aircraft Factory where it was officially stated only experimental machines were being built. We were able to place little faith in this assurance for the industry was only able to secure small orders, and these were invariably only procured after endless agitation both in Parliament and in the Press.

Even when our machines were purchased by the Army we found that when they were in need of repairs and renewal they used to be sent to this Factory which most of us regarded as being our most dangerous competitor. Colonel Seely had stated that the Royal Aircraft Factory had designed the 'best machine in the world'—a statement which few of those in the aviation world believed could be supported by performance, but it did help to further hinder the progress and development of British aviation.

Later Colonel Seely announced in Parliament that the Army possessed one hundred aeroplanes, a statement which was promptly contradicted by Lord Montagu of Beaulieu. As the result of an investigation it was shown that the Army did possess one hundred aeroplanes—of a kind, but actually the majority were only suitable for school training purposes.

Later Colonel Seely increased the numbers to one hundred and twenty machines. These figures were again contradicted by the late Mr. Joynson Hicks (later Sir and then Lord Brentford) with the result that he was allowed to go round the flying centres to inspect the aeroplanes.

This was how the total of 120 machines was made up :

43 ready to fly
7 under test
24 under repair
9 total wrecks
3 experimental ready to fly
9 under reconstruction
25 monoplanes

Out of this total twenty out of the forty-three claimed as being ready to fly were at the Central Flying School where they were being used for instructional purposes. And of the monoplanes only two were on the flying list.

Just before the outbreak of war there was a mobilization of the Royal Flying Corps when about seventy aeroplanes and six hundred officers and men were gathered on Salisbury Plain. There were at that time five squadrons in Britain with a full paper strength of 125 aeroplanes and 1100 officers and men. This offers an interesting comparison with present-day figures and indicates how far our ' civilization ' has ' progressed.'

In 1914 the War Office issued specifications for the various military types which they required. Although only twenty-five years ago nothing shows better the vast changes in design and accomplishment. The requirements then seem to-day almost childishly simple.

CHAPTER SEVEN

MORE BROOKLANDS DAYS

AFTER the excitement and interest of the Military Trials I was glad to find myself once more back at Brooklands where there was never-ending experimental and other work to be carried out.

At this time we had a flying school, at which some of the pupils paid for their tuition, whilst others used to work for a certain time in return for an hour's flying instruction. Or perhaps it would be more correct to say that some worked, whilst others amused themselves in other ways.

There was one rather hefty pupil who had paid us £25 for tuition and was getting on well with his lessons, but I became rather concerned for his safety during some of his solo flights. He was a very nice young fellow, but an only son, and at last there came a time when we had no machine left in action. It was not his fault for somebody else had broken up the machine, but after a few days of idleness he became dissatisfied, and came to me demanding his money back, or at least a portion of it. I was sitting in my so-called office at the time. It was simply a screened-off portion of one of our hangars, and I pointed out to him that I would have to refer the matter first to our works at Manchester where our financial affairs were handled.

"What," he said, "you won't give me back my money now?" and he began to rain on me blow after blow with his tightly clenched fists until he had cut several parts of my face rather badly. I was helpless,

with no chance to defend myself. When he had exhausted himself he left me, and walked out. I was, of course, boiling with rage, and felt at the time like murdering him, so I seized hold of some tool or other, and ran after him with the most violent intentions. On the way, however, I met S. V. Sippe who was also working with me at the time, and he, seeing the state I was in, persuaded me to let the matter drop and get my wounds dressed. I went for a holiday to recover from my wounds and was awarded £50 damages.

Later on this same pupil was one of the first fliers over Everest, and it was only quite recently that we met again at a friend's house for dinner and we had a good laugh over an episode which was not very pleasant at the time. We are quite good friends now and I am sure he will never want to hit me again.

It was S. V. Sippe who made that gallant raid on a Zeppelin shed at Friedrichshafen on 21 November 1914, with Squadron-Commander E. F. Briggs and Flight-Commander J. T. Babbington. They were all using standard 'Avro 504's,' and started on their raid from Belfort in South-eastern France with machines which were built at our Manchester works, and had not even been tested before they were sent out to France. There they were taken out of their cases and assembled, and the three men set out almost at once, in the depth of winter, for an objective which was 150 miles away. Briggs was shot down when only a few feet over the shed, the bombs he dropped through the roof must have done some damage. He was made a prisoner and was very roughly handled in the excitement of the arrest, but was treated very well afterwards. Briggs managed to escape after about two years. Sippe and Babbington reached their objective and, I believe, succeeded in doing very considerable damage to the huge shed with the airship inside it.

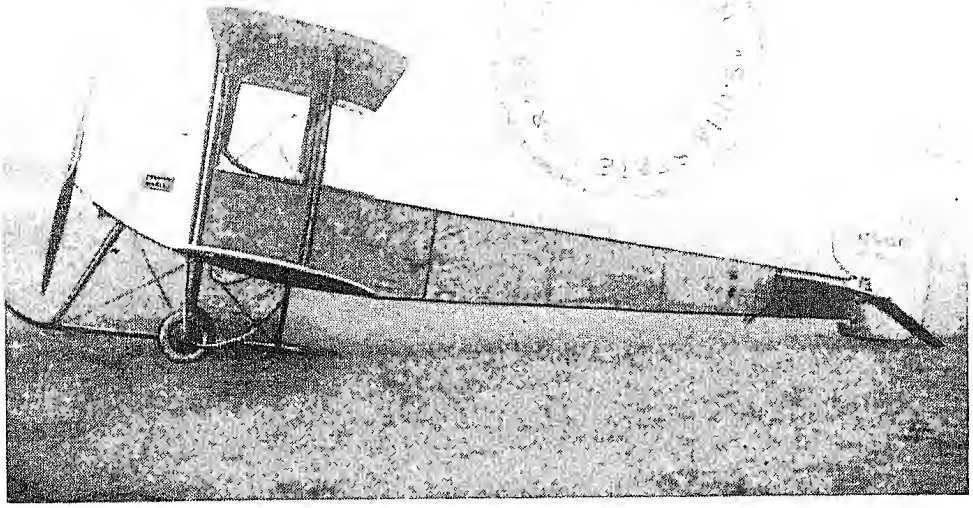
To return to Brooklands. There is one interesting

record that the 'Avro' machines possess in that in taking the years before the War, the War years, and the years after the War up to the time of the R.A.F. expansion, more pilots have learnt to fly on them than on all the other makes put together. Certainly no one other make has trained so many aviators.

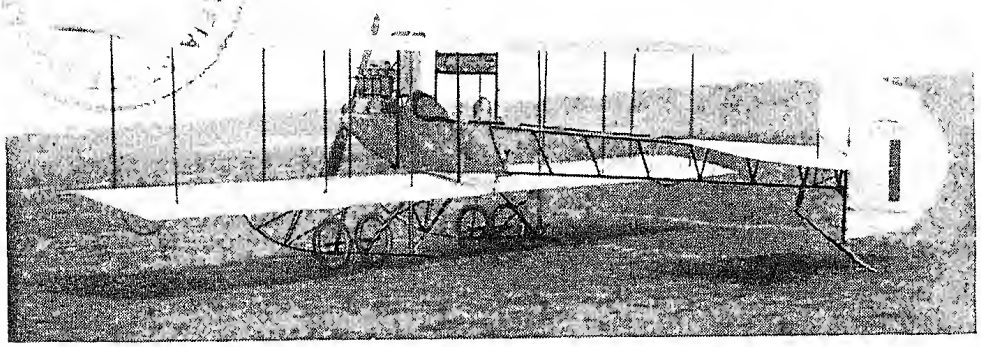
At that time we had three pilots giving our pupils flying instruction. Our first instructor was Pixton, who had been with us from the earliest days on my return to Brooklands. He had come as a working pupil. Then he was at Blackpool when we had the tragic accident in the burning of our machines. After that he came with me on the American trip. On his return he took his 'ticket' on an 'Avro' triplane. It was number 50 so he can claim to be one of the first test pilots. Later he was to get considerable publicity for his association with the British victory in the Schneider Maritime Trophy contested at Monaco in 1914, but his services to aviation were actually far more important.

Howard Pixton was an extraordinarily methodical and careful man and he had a most lavish regard for looking after small details. When he competed in an air race he used to have a card in the cockpit of his machine, and on this card he placed a number of drawing-pins corresponding to the number of laps he had to cover. As each lap was completed he drew out one of the drawing-pins, thus making sure he was keeping correct count, for it often happened that other competitors failed to keep an accurate tally and thus lost the race.

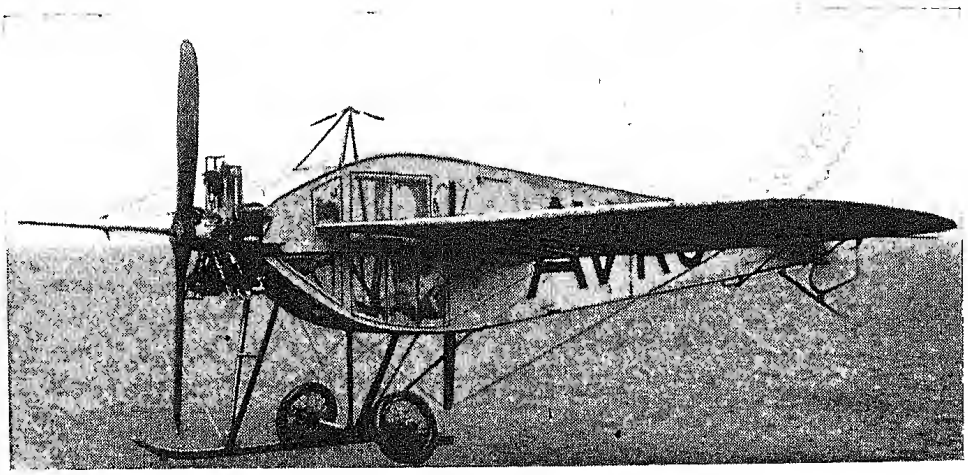
In May 1911 he competed on one of our machines in the first Brooklands–Brighton race. It was his first cross-country journey and his compass proved so inefficient that he lost his way badly and was forced down at Plumpton. About the middle of 1911 he joined up with the Bristol Company, and in the years



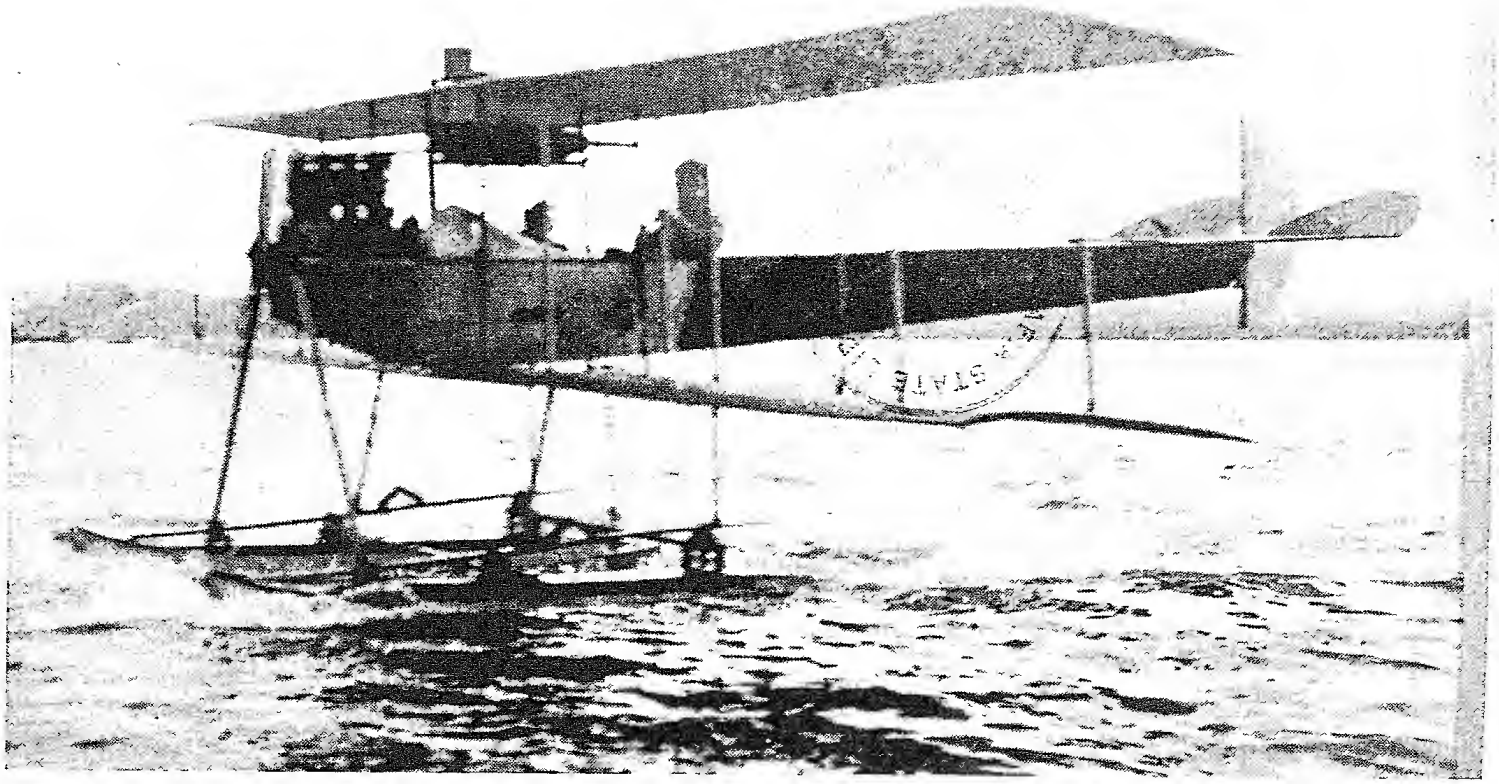
'AVRO' BIPLANE, 1913



'AVRO' 35 H.P. BIPLANE, 1912



'AVRO' MONOPLANE, 1912
First enclosed aeroplane to fly in the world.



EARLY 'AVRO' BIPLANE FITTED WITH FLOATS
First seaplane to fly in England. Flown by S. V. Sippe.

before the War he visited many parts of Europe demonstrating their machines to foreign Governments. During the War he received a commission in the R.F.C. and at the end of the War he returned to our firm and did valuable work for us in our attempts to popularize flying.

Our second instructor-pilot was F. P. Raynham who came to us first as a youngster. He was, in my estimation, one of the finest pilots I have ever seen. He had an astounding knack of coaxing machines off the ground when no one else could. He took part in many races and competitions on 'Avro' machines. His 'ticket' number is 85.

Then we also had Ronald Kemp, another youngster who developed into a remarkably fine pilot.

There was one thing we all had in common ; it was that everyone was intensely keen on their work and the machines that they had to fly.

The system of flying tuition prior to the War was of a very primitive kind. The pupil was first taken up on a machine fitted with dual control. When the instructor considered that the pupil was able to fly solo, he was then allowed to go up alone. The qualifications for taking an Aero Club 'ticket' were simple in the early days, for all that a pupil had to do was to make a couple of flights and make his landings near the spot from which he had started. Early in 1911 the regulations were made more difficult, although from modern-day standards they would seem to be ridiculously simple. A pupil had to make two flights, each consisting of five complete figures of eight, and each flight had to be of a distance of at least three miles. It was also necessary that the machine should attain an altitude of not less than 165 feet. Then, in alighting from each of the flights, the engine had to be stopped prior to the machine touching the ground, and the aeroplane brought to rest within a distance of

about sixty yards from a spot which had previously been indicated.

Many fliers in those days considered it to be unsafe to fly unless there was practically no wind. Thus at Brooklands most of the flying was done either very early in the morning or at dusk just as the sun was setting. At these times there was generally an absence of air disturbances which were considered dangerous. Personally I used to prefer a wind as this reduced the take-off and distance necessary for landing. These shortened runs minimized the stresses on the under-carriage, thus possibly saving it from collapsing, which it often did if there had to be any extended run on the ground prior to getting into the air or on landing.

Our first Regular Army pupil was Captain W. G. Beatty of the Royal Engineers. Later he became a Lieutenant-Colonel in the R.A.F.

Then there was Lieutenant Parke, R.N., whom I have already mentioned in connection with our entry at the Military Trials. He had obtained a year's leave from the Navy in order to devote himself to flying. He was a very fine pilot, and a most amusing character. His death in 1913 from an accident in an aeroplane of another make was a very great blow to us all, and he was very much missed.

One of our cheeriest pupils, who had a most engaging smile, arrived one day at Brooklands in a very smart, closed motor car in which, he told me, he was going to set off on a touring holiday. A few days later a policeman called and informed me that the motor car was a stolen one. Shortly afterwards our pupil was arrested and sent to prison for a few months.

Some time later we heard of a wonderful revolutionary invention which was referred to by Major-General Seely in his speech on the Army Estimates. This invention, he informed the House of Commons,

was going to give Britain a striking advantage over the air fleets of all the other Great Powers, for it appeared that the inventor had invented a wireless ray which could stop the magneto of an aircraft engine functioning during flight. The matter became a nine-days' wonder. Obviously such an invention, if it was genuine, would have been of the very greatest value, and the War Office, rather innocently, jumped at the idea.

But the inventor proved to be none other than our old pupil, refreshed for new fields of endeavour after his period of prison detention.

The War Office corresponded with him, offered him the opportunity of experimenting on an army aeroplane at Salisbury Plain, and he was told that if his apparatus was effective the War Office would consider buying it from him.

In the meantime the 'inventor' had been able to extract hundreds, if not thousands of pounds, from people on the strength of his correspondence with the War Office and the optimistic statements of Major-General Seely. There was one thing which, one might have thought, might have warned the gullible investor. It was that he regarded his invention as being so secret that not even his financial backers were allowed to see it.

The 'inventor' accepted the invitation to demonstrate at Salisbury Plain, and the packing-case containing the marvellous 'invention' arrived a day or two before the demonstration. At last the eventful day arrived and a number of prominent officials gathered round full of excitement waiting for the great man himself to turn up. But the 'inventor' did not arrive. Telephone calls were put through. Finally suspicions were aroused. It was decided to open up the packing-case.

When opened it was found to contain nothing but rubbish.

The War Office had been badly hoaxed.

There was another quaint, but quite honest character of the old Brooklands days. He used to live in the same apartments with me at Byfleet which was close to the Brooklands track. His name was R. F. Macfie. He was of Scottish descent, but told me that he had been born on one of the South Sea Islands. He had had an engineering training in England and had later worked in various parts of the world. Early in 1909 he had returned to Europe and taken an active part in aviation, which included the construction of machines to his own designs. He experienced considerable difficulty in getting a suitable aerodrome on which to carry out his trials and had also had a fair share of bad 'smashes.' At last he came to Brooklands and at the time I knew him he was in partnership with the late Major James Valentine, better known as 'Jimmie,' who had supplied Macfie with a 'Gnome' engine.

Our landlady usually used to ask us each morning what we would like for lunch and dinner. I would give my orders, and there being no response from Macfie, the landlady would ask him again what he would like. Then came always the same reply, spoken in his outspoken breezy, American accent: "Scrambled eggs, Mrs. Pantling—scrambled eggs!"

One day I asked him if he particularly liked scrambled eggs, seeing that he always ordered them when asked.

"No," was his rather astonishing reply, "but if Mrs. Pantling cannot think of something, I'm not going to think for her."

Macfie often used to tell me that there was nothing in aviation and strongly advised me to go to America and make my life there.

. . . . .

In writing of the past I do not like to say that I designed this or that aeroplane, for even if a machine

is of one's own conception, yet there must necessarily be others who have played an important part in its final details and construction. Pioneers in any line are sure to have assistants who think they have done the deed themselves, and perhaps the following instance may indicate this trait.

At Brooklands in 1911 an Indian student joined us. As he had some drawing-office experience at a technical college, he assisted me in getting out the drawings of the '500' and '501' types, which were then sent to our Manchester works to be actually built. I noticed whenever I had occasion to leave the aerodrome that on my return little had been done. I asked him the reason, and he always had some excuse that he wished to ask me about some detail or other. Later he returned to India, and one day I received from him an Indian newspaper in which I read an account of a dinner that was given to him to celebrate the fact that he had been responsible for designing an aeroplane which had been ordered by the British Government in large numbers!

I had my own way of designing at that time. Take the wings for instance. My original scheme was to work out the size that the machine was going to be according to the weight it would have to carry, and from that I would calculate the angle of the wing, the size of the spars and the distance apart that they would have to be. Then I would draw the spars in section in their relative positions and round them I would sketch freehand what looked like being the best wing-section which would enclose these spars. My method may have been primitive, but it was effective. Obviously as we made more progress so we adopted more accurate and scientific methods. We also now have a considerable amount of data to draw upon.

In 1912 we made the first British seaplane. It was the old original 'Avro' biplane with the 35 h.p.

'Green' water-cooled engine, and it was purchased by Commander Schwann, R.N., who was then stationed at Barrow-in-Furness watching the construction of the airship which was rudely named the *Mayfly*—because it didn't. He is now Air Vice-Marshal Sir Oliver Schwann, K.C.B., C.B.E., R.A.F., retired.

Commander Schwann had his machine built on to floats and sent by rail to Barrow. He boldly took it out into the harbour, opened out his motor, pulled the machine off the water, and then promptly slid backwards into it.

Being a gallant sailor this did not deter him and he had the machine rebuilt. But on its next trial flight he got S.V. Sippe to pilot it, which he did successfully.

In 1913 we produced a machine which was to become very well known. It was the 'Avro 504.' In view of the great part it played in the history of flying and in the fortunes of our firm, I am giving a chapter to its story. This machine made its first public appearance at Hendon one Saturday when many marvelled at its amazing speed range.

F. P. Raynham was piloting the machine, and he surprised everyone by crawling round the course at what appeared to be an absurdly slow speed, then opening out to full speed. In fact, he put up the fastest and slowest times round the course, beating the performance of all the machines including the monoplanes. Up to that time flying had generally been done at one speed, so that Raynham's wide speed variation was particularly noticeable. Another sensation which he caused shortly afterwards was when he made a glide from Brooklands to Hendon, a distance of about 21 miles. To achieve this he shut off his engine after climbing to 14,000 feet over Brooklands, and he was still 5000 feet up when he arrived over Hendon.

Several of the Hendon pilots were given the oppor-

tunity of flying the '504' and they were unanimous in their praise of its fine qualities, but nobody could have then foreseen that, with various modifications and amendments, it was destined to be built in thousands. Actually during the War alone our firm built close on ten thousand machines of this type, and outside contractors built a similar number. Compared with the '500,' the first '504' had a fuselage of better streamline shape, curved side fairings and decking having been added to the rectangular section main fuselage structure. A 'Gnome' engine of 80 h.p. had been substituted for the 50 h.p. 'Gnome' of the '500.'

The central skid which had been a familiar feature of the '500' was retained, but instead of using the leaf-spring axle the '504' had telescopic struts with rubber-cord shock absorbers enclosed in streamline fairings. The leaf-spring axle of the '500' had always been very 'squashy,' and something of the same quality was retained in the '504,' which may have partly accounted for its popularity in school work. Other features which appealed were the pronounced stagger and the long slim fuselage. All these features were pet details of mine.

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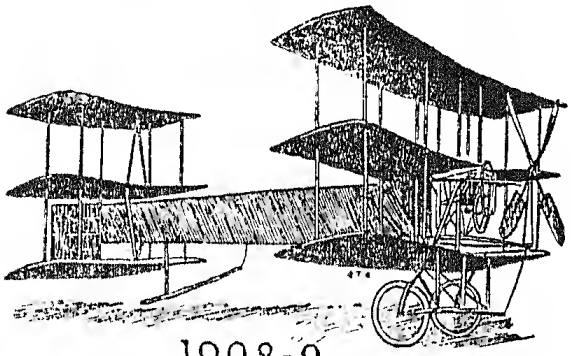
The developments which had taken place in aviation since I had made my first flight at Brooklands were remarkable as the records of the first few years will show:

HEIGHT

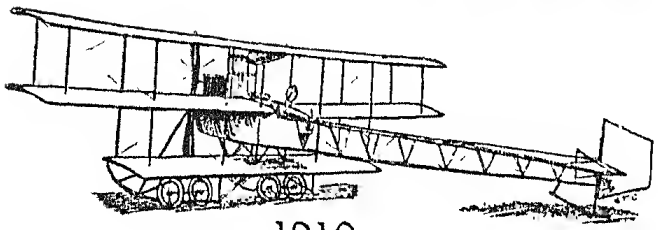
1908. Wilbur Wright (Wright biplane) 328 feet.
1909. Paulhan (H. Farman biplane) 1558 feet.
1910. Hoxsey (Wright biplane) 11,474 feet.
1911. Garros (Blériot monoplane) 13,947 feet.

SPEED

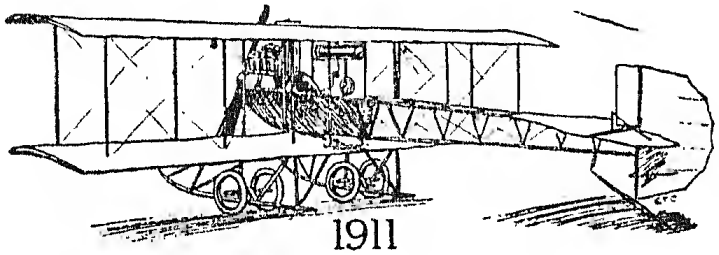
1908. Wilbur Wright (Wright biplane) 39 miles an hour.



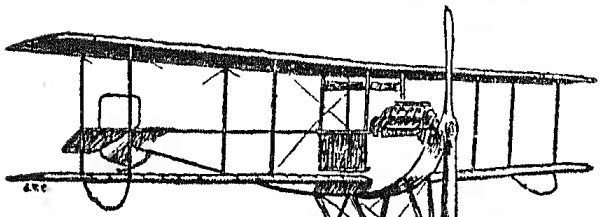
1908-9



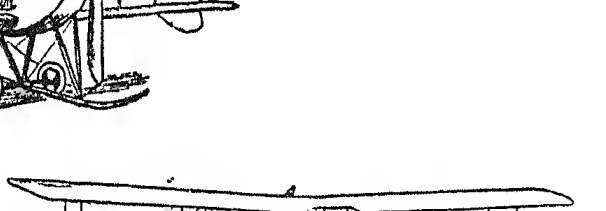
1910



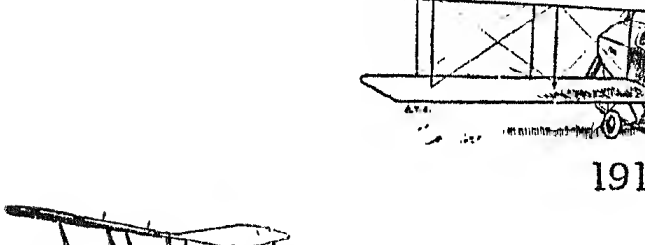
1911



1911-2



1912



1913-4

AVRO TYPES (Pre-War).

1909. Delagrangc (Blériot monoplane) 50 miles an hour.
1910. Leblanc (Blériot monoplane) 67·5 miles an hour.
1911. Nieuport (Nieuport monoplane) 82·5 miles an hour.

Distance in a Single Flight

1908. Wilbur Wright (Wright biplane) 77·6 miles.
1909. Farman (H. Farman biplane) 144·5 miles.
1910. Tabuteau (H. Farman biplane) 365 miles.
1911. Gobe (Nieuport monoplane) 462 miles.

Duration of a Single Flight

1908. Wilbur Wright (Wright biplane) 2 hrs. 20 mins. 23 secs.
1909. Farman (H. Farman biplane) 4 hrs. 17 mins. 53 secs.
1910. Farman (H. Farman biplane) 8 hrs. 12 mins.
1911. Fourny (M. Farman biplane) 11 hrs. 1 min. 29 secs.

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One of the features of pre-War flying, especially in the years 1912, 1913, and 1914, was the number of flying meetings which used to be held. Hendon was the main centre for these and during each of these years frequent meetings were held at which thousands of pounds' worth of cash prizes and trophies were presented for competition. At that time the fame of Hendon was inseparably wrapped up with the name of that great pioneer flier, Claude Grahame-White, who I still often meet travelling between Cowes and Southampton. But a great deal of their success was due also to others who were connected with him. I refer to the late Richard Gates and Mr. Bernard Isaac.

Richard Gates was Grahame-White's manager at Hendon, and it was very much due to his work and

ability that the aerodrome became the famous place it was. He had had a varied career and was most unfortunately killed shortly after the outbreak of war in a night-flying accident at Hendon. I remember his once telling me that he could sell a hundred of our '504's' if he had the handling of their sales. I laughed at this and regarded what he had said as being a joke for I very much doubted his ability to accomplish such a feat, for at that time half a dozen machines constituted a big order and was something to talk about. Actually we had made only the one machine. Little did I think then, even in my wildest dreams, that before long we should be producing this machine, not in hundreds, but literally in thousands.

Later the *Daily Mail* bought our original '504,' and we fitted it with floats which could be easily and quickly changed for a land under-carriage. It was flown at a number of seaside and inland towns including Birmingham, where the reservoir was used in the absence of an aerodrome near by. The Admiralty and War Office also gave a few orders, and the aircraft industry did begin to show signs of possibilities. Rival constructors were growing into manufacturers, and orders from various sources were beginning to come in. But the few orders we did get were hardly sufficient to carry us on financially for any length of time and again we were beginning to consider whether we could carry on much longer. Then a fortunate event took place which gave us a good deal of encouragement. We received an order from Germany for a seaplane, and this machine which we supplied was the first machine to fly from Germany to Heligoland. The Germans built a number of machines on similar lines and used them during the War which broke out shortly afterwards.

To return to the matter of meetings at Hendon. On occasion we used to enter machines for certain races. The most important event, undoubtedly, was the

'Aerial Derby,' which was an annual race round London. The distance was about 80 miles—a distance which now would be covered in a few minutes, but in those days the speed of even our fastest machines was very much slower. For instance, in 1912 the race was won by T. O. M. Sopwith whose average speed was only 60 miles an hour. In the following year the length of the course was increased to over 90 miles, and the winner's speed was 76 miles an hour.

Nowadays our amusements of yesterday might seem very tame, yet there were thousands of people who used to go weekly to Hendon to watch the thrills. It may be of interest to show what a programme consisted of. The following is that held on Easter Monday, 1912 :

12 to 1.30	Parade of aeroplanes.
1.30 to 2.30	Biplane handicap speed contest. Eight laps (twelve miles). Open to all types of biplanes. Prizes, 20 sovereigns and 10 sovereigns.
2.30 to 3.30	Speed contest. Third day (final ten laps).
3.30 to 4.30	Cross-country handicap. Hendon to St. Albans and back, about 22 miles. Open to all types of aeroplane. Prizes, 50 sovereigns and 20 sovereigns.
4.30 to 5.30	Relay race. Four laps (six miles). Competitors will start in pairs, monoplane and biplane. The monoplane of each pair is to fly the first two of the four laps from a standing start. On landing as near as possible to the starting-point the pilot will run to the judge's enclosure and obtain a dispatch. He will then run to his team-mate's two-seater biplane, and get on board as passenger. The pair will then fly the remaining two laps, finishing as near as possible to the judge's

box ; both will dismount and run to the judge with the dispatch. Time will decide the contest. Prizes 20 sovereigns and 10 sovereigns.

5.30 to 6.15 Altitude passenger-carrying. Open to all types. Prize 25 sovereigns.

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In August 1913 the *Daily Mail* offered £10,000 in prizes for a seaplane race round Britain. It was restricted to British airmen, British machines, and British engines. The course was 1540 miles in length and it had to be covered in less than 72 hours. The route was by Southampton, Dover, Yarmouth, Scarborough, Aberdeen, Inverness, Oban, Dublin, Falmouth, and back to Southampton. There was endless trouble over this race. The Admiralty raised all kinds of objections over aeroplanes flying near their Naval bases, and there had to be considerable amendments of the course. Finally, after a lot of trouble, four machines were entered. There was Cody with his aeroplane, Sopwith with a Sopwith seaplane, Mr. F. K. McLean on a Short, and Mr. J. Radley and Gordon England on a Radley-England machine.

Cody was killed in an accident just before at the race at Farnborough. Radley and Gordon England withdrew their entry, and Mr. McLean also had to withdraw owing to engine trouble. This left only the Sopwith machine which was being flown by H. G. Hawker. He managed to reach Yarmouth, but had to give up owing to illness. He was replaced as pilot by Mr. Sydney Pickles, but heavy waves prevented the machine from getting off the water so the attempt had to be abandoned. But after a week Hawker decided to try once more, although there were only five days left in which he had to complete the course. He set out, but was dogged by incessant trouble which

culminated in his machine plunging into the sea near Dublin and causing such damage that he had to abandon the race. Hawker was not hurt much, but his passenger Kauper had a broken arm and other injuries.

Lord Northcliffe gave £1000 to Hawker for his very plucky attempt on the prize.

The following year, in 1914, the same race was to be repeated. We built a seaplane and sent it to Calshot, which was to be the starting-point. On my way down by road to attend the erection of the machine I put up for the night at an hotel at Havant, near Chichester. Early in the morning I was awakened by someone running down the road shouting out: "England declares war on Germany." I jumped out of bed with mixed feelings which many of us experienced on that momentous occasion and I stood, for some time, looking after the retreating figure wondering what the future held in store.

Meanwhile our seaplane flew well, for we had fitted it with floats which aft of the step tapered to the rear, allowing more gentle alightings on the water than previously. Our pleasure at the successful results was soon turned to disappointment, however, when later the floats were replaced by the flat back-type of a rival constructor. To us there appeared no room for doubt as to which type was the better, and subsequently actual practice proved that we were correct. Eventually our machine was bought by the Government and I still remember the surprise I experienced, and also the delight, when I received a cheque on the spot, handed to me by Captain Longmore, now Air Vice-Marshal Sir Arthur Longmore, D.S.O.

I was sorry the race did not take place for we had expected it to be keenly contested. But alas! 'Der Tag,' as far as Germany was concerned, had arrived. We had to concentrate all our efforts for the next four years on other things than races.

CHAPTER EIGHT

THE WAR—AND AFTER

WHEN war broke out all the aeroplanes in Britain which were of any use were commandeered. In the early days of the fighting in France a few 'Avros' were used there, including those in the raid on Friedrichshafen. There came a certain increased demand at our works, but it was nothing like the output for which we had to cater later on.

At the start of the War the 'Avro' was not popular as a training machine, and it was not until Lieutenant-Colonel Smith-Barry and his staff organized the School of Special Flying at Gosport and decided to use only 'Avro 504's' that we got into real production. Up to that time our works received orders for machines in batches of fifty or so at a time.

Although the greater part of our output was taken up with the '504,' yet we found time to design a considerable number of other types during the War. One of these machines was the 'Pike' which had the series number 529. It appeared in May 1916 and it was the first twin-engined machine we had produced; in fact it was one of the first produced in the world.

We did much valuable experimental work as regards different directions of turning the propellers. Clockwise in both cases or anti-clockwise, or both turning inwards or both turning outwards. This information was available to other builders and the Government. The 'Pike' was fitted with two Sunbeam engines, each of 160 h.p. which drove 'pusher' airscrews. A second

machine came out in August of the same year, and this type had two ' Green ' 150 h.p. engines. In this model, however, the airscrews were in front of the wings. A two-seater fighter with a 200 h.p. Sunbeam ' Arab ' engine appeared in July 1917. This was known as the ' 530,' and it had a top speed of 118 m.p.h. The crew of the machine sat high up looking over the top wing, and the raised top-decking gave the machine a very modern appearance.

Another machine we had going through the shops at the same time as the ' 530 ' was a twin-engined three-seater bomber—the ' 529A '—which was fitted with two 220 h.p. ' Galloway ' B.H.P. engines. The speed of this machine was 116 m.p.h. and it carried a military load of 1280 lbs.

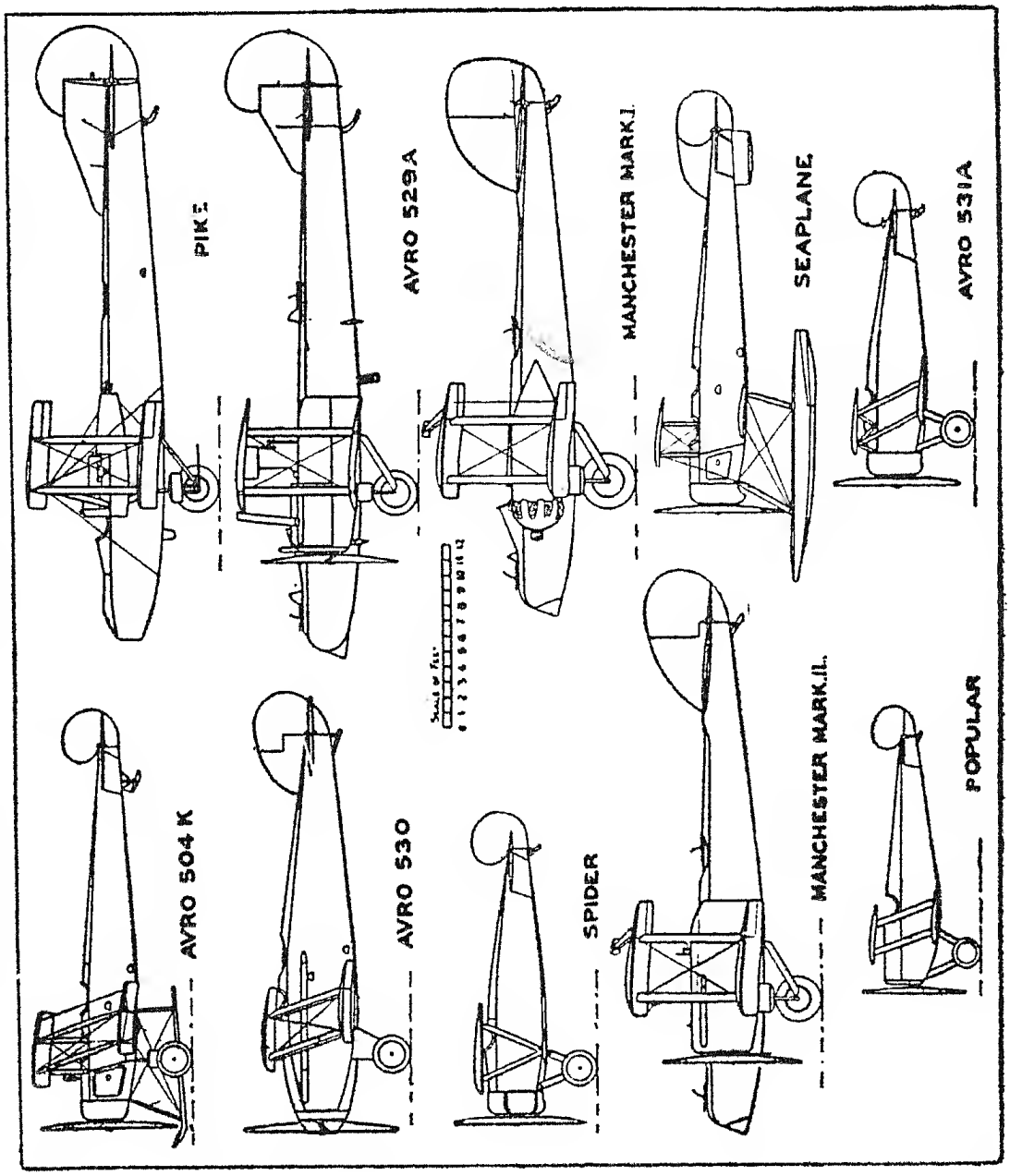
Of totally different type was a little single-seater scout which we brought out in the early part of 1918. With a lower wing having a very small chord the ' 531 ' was rather reminiscent of the French Nieuport scouts. However, the wing bracing was unusual and consisted of two sets of Vee struts, the feet of which met on the top of the lower wing near the tie, and the tops of which braced the two spars on the top plane. This machine became known as the ' Spider,' and with a 110 h.p. ' Le Rhone ' rotary engine it had a top speed of around 120 miles an hour. In a modified form it was revived as the ' 531A ' in 1919.

Early in 1918 the A.B.C. ' Dragonfly ' 320 h.p. engine began to go into production, and we designed a twin-engined machine for it. This became known as the ' Manchester,' but as we had difficulties over the engine supplies we reconstructed it in a modified version which was known as the ' Manchester, Mark II,' and this was fitted with two Siddeley ' Puma ' engines of about 300 h.p. each. In the ' Manchester ' we used the type of aileron balance which later became known as the ' park bench.' Used, I think, for the first time,

it was a small auxiliary aerofoil carried on two brackets from the top of the aileron, placed above and slightly ahead of the hinge line.

During the War the authorities found it necessary to give sub-contractors the task of manufacturing the 'Avro 504' as we were quite unable to meet the demand. About eighteen sub-contractors were chosen. I wanted to place the making of parts out to the sub-contractors and then to have four erecting stations for the completion of the machines; two of these would be at our own works—one in Manchester and the other at Hamble; then there would be another erecting station operated by the Brush Electric at their Loughborough (Leicestershire) works, and the last station was to be at the Grahame-White works at Hendon. But this idea was turned down for they were all against the plan, the excuse given being that a general parcelling out of erection would be safer in case of air bombing, for if one of the builders of complete 'Avros' was wrecked then the result might be that a large number of parts makers would be held up, whilst if only a sub-contractor was bombed then the others would carry on without interference. Actually, of course, it gave many firms, as they thought, a good chance to enter the aircraft industry. One result of the scheme which was adopted was that the best of the sub-contractors took a year to deliver their first aeroplane, and even when they did get into production we found that the most popular machines in the Royal Flying Corps were those which were constructed at our own works.

At the time at which the '504' was being ordered in quantity it was found necessary to alter the engine plate so that it could take the various types of engines, by employing adaptor rings. I thought this was an excellent opportunity to re-design the plate which had a number of triangular lightening holes with



AVRO TYPES (War and Post-war).

flanged corners of small radius. These sometimes used to crack on flanging.

So I submitted a very simple design, cutting out the neutral axis as far as possible, producing a very light and strong plate. There were only four simple flanges. However, the official attitude was dead against my design, and an alternative one was introduced.

In connection with this matter, amongst others, I attended a meeting at the Hotel Cecil. There must have been quite a dozen 'experts' present, some representing the different Services and clad in varicoloured uniforms. I recollect a Royal Naval Air Service officer saying: "My experience shows that the struts on which the engine mounting is attached become saturated with oil, and I do not think there would be sufficient bearing surface." I countered his arguments on this criticism of my proposed plate. There were other arguments brought forward, but the discussion ended in the decision to produce an engine plate which was twice as heavy as the one I had planned; and there was practically nothing in it on the load deflection tests.

I mention this matter as an illustration of how officialdom often spoils the performance of a machine. It could, of course, be illustrated with many other instances, but this one will suffice.

Amongst the other machines we designed during the War were a small single-seater scout, a very clean two-seater fighter biplane, and a large bomber which was fitted with the first 1000 h.p. engine which was a 'Napier.'

Towards the end of the War I, with other aeroplane constructors, was invited to go to France and visit the aerodromes there. General Trenchard, now Lord Trenchard, who was popularly known as 'Boom' because of the sound of his voice, met us on arrival and gave us certain information about our visit. The

object was to acquaint us with the actual fighting conditions under which our machines had to work. I was greatly impressed at the time with General Trenchard, for he was a very forcible character. I also found it extremely interesting going round the various aerodromes where there was also the added excitement and thrill of some spare shot or bomb landing near one, although actually I was spared this thrill, although I happened to be in London for nearly every raid there. On our way back we visited some aeroplane works in Paris, and it was during our stay in that city that the Armistice was fortunately declared. I still remember vividly the mad excitement of the people as they celebrated the ending of that terrible struggle in which there had been so much destruction and so many young lives lost. I felt very sorry for some of the victims of the so-called practical jokes which occurred, such as turning cabs over and then kicking the drivers' hats about like footballs.

With the cessation of hostilities my firm at once realized we would have to adapt ourselves to changed conditions. This, however, was not easy. We were one of the first concerns to develop a large 'joy-ride' undertaking which went under the name of 'Avro Civil Aviation Services.' This company established flying centres at many seaside and inland resorts. The idea emanated when Captain Scott and several other keen Royal Flying Corps officers approached us about obtaining employment. We supplied the machines of which quite a number were second-hand 'Avros' purchased from the Air Ministry. These were converted for passenger-carrying purposes. We carried on this business for three to four years, but lost a lot of money. During this period our machines carried over 30,000 passengers, so we played an important part in making the people of Britain air-minded. We

were also able to claim that not one of our paying passengers was ever seriously injured.

Generally, however, existing economic conditions were against us. We had to discharge more than half our employees, for Government orders had stopped almost entirely.

It was early in 1919 that we produced the first modern light aeroplane. This was first known as the 'Avro Popular,' but was later renamed the 'Avro Baby.' It had the identical 35 h.p. 'Green' engine which I had used in one of my 1910 triplanes. This little machine was very successful. It was certainly not a toy, for it was on this machine that the late Bert Hinkler made his famous non-stop flight from Croydon to Turin in $9\frac{1}{2}$ hours.

Bert Hinkler was a little Australian who had enlisted in the R.N.A.S., and after distinguishing himself in Italy during the War had won a commission for himself on the field. He worked for a time in our works. Then he set out on making his record-breaking flights to and from Australia, and he was really the first of the Australian record-breakers using light machines. His chief mount was one of our 'Avro Avians' with a 'Cirrus' engine. On this he accomplished many very fine flights. Not only was Hinkler one of our best test pilots, but he was also a very practical inventor. His death at an early age was a great loss to British aviation. It occurred while he was on one of his record-breaking trips to Australia when he flew into a mountain in Italy during a snow-storm. The Italian *Regia Aeronautica*, the men among whom he had fought, buried him with full Air Force honours.

Another interesting production was a triplane which was designed for commercial purposes. It was made largely of spares of the '504,' and it competed at the Commercial Air Trials.

It was not until 1923 that Sir Samuel Hoare and

Lord Trenchard started to rebuild the Air Force. Then we were able to commence construction again.

With the rebuilding of the R.A.F. there came a fresh demand for training machines, and our firm was called on to produce variants of the '504K' which culminated in the 'Avro Lynx'—the '504N'—which had the reputation of being the most unbreakable machine ever built.

Of the military types that the firm produced in these post-War years I will only make brief mention of some of the more important models.

In 1925 there was the 'Avenger,' a single-seater fighter with a Napier 'Lion' engine; this machine had a speed of 180 m.p.h. Among heavier types there was the 'Aldershot' bomber which had a Rolls-Royce 'Condor' engine. This was produced in 1920–21. Then there was the 'Bison' with Napier 'Lion' engine that made its first appearance in 1921–22. In 1923 there came the 'Ava' with two Rolls-Royce 'Condor' engines; and in 1924 there was the 'Andover,' which was actually an ambulance version of the 'Aldershot.' In 1925 there was the 'Avro Buffalo' torpedo-carrier, and the following year saw the 'Avocet,' which was a single-seater fleet fighter with stressed skin construction.

We made a return to light aeroplane construction in 1926 when the first 'Avian' with 'Cirrus' engine appeared. Large numbers of this machine were built, the first being of wood, but later machines had welded steel tube fuselages. It was on the original 'Avian' that Hinkler flew from Croydon to Australia in 15½ days, a record which remained unbroken for three years.

The 'Avro Antelope' day bomber was produced in 1927. It was mainly of duralumin construction including the covering-in of the flat-sided fuselage.

Since then A. V. Roe and Co. Ltd., have been

engaged on many other new types including a more modern type of the '504,' which had for twelve years been the standard training machine of the Royal Air Force. This new machine was the 'Avro 621,' and it was selected after prolonged and severe testing. It went into service as the 'Avro Tutor,' and the Siddeley 'Lynx' was chosen as its standard power plant. A development of the 'Tutor' was the 'Cadet'—'Avro 626,' and it was designed to facilitate training in all military duties such as gunnery, bombing, blind flying, telegraphy, photography, etc. It is of interest to note that both the 'Tudor' and the 'Cadet' are still very like the '504' in general appearance.

At one time we had close connection with Señor Cierva, one of the originators of the auto-giro. He had been using an 'Avro' fuselage in his experiments, so when he came to England about 1920 he met me, and we decided after discussing the matter with him that we should build his machines for him. We built a number of these machines, and I was rather keen on Cierva trying out some of my own ideas with controlled blades and developing a helicopter, a type of machine on which experiments had already been carried out by other designers in addition to Cierva.

Mr. Whimperis, who for many years and until recently was Director of Scientific Research at the Air Ministry, wrote to me asking what I thought of the future of the auto-giro. This inquiry was made at a time when they were still very much in the experimental stage—some twelve years ago. I replied saying that I thought the Air Ministry should give every assistance to this type of machine and this the Ministry did to a certain extent, although I think there is one very promising British firm which received no financial support, although it has turned out a very promising machine.

In time the auto-giro will no doubt be developed

into the helicopter. Such machines will be able to dart about like humming-birds. Obviously aircraft can never be used like motor cars until it is possible to get off the ground easily and safely. Such areas as ordinary lawns with trees around must, in time, become individual aerodromes where the private owner can ascend or land again as the case may be. Should the engine stop the machine will then become a steerable parachute and land gently.

There was yet one more branch of aviation in which our firm interested themselves during the years following the War. We built a number of motor gliders which turned out to be highly effective. At the Lympne Light Aeroplane Competition one of our machines took first prize. Roy Chadwick designed the biplane which we entered, and I was responsible for the monoplane. This latter had a wing span of 36 feet. There was also a spare wing of 30 feet span which only weighed 95 lb. ; yet it was extraordinarily rigid compared to other monoplane wings. Hinkler won a duration prize on this machine which did, I think, 1000 miles. He declared it to be one of the nicest machines he had ever flown.

The 'Avro' light biplane, '558,' had a $2\frac{1}{2}$ h.p. 'Douglas' engine. This machine was flown by Wing-Commander Hammersley to a height of 14,000 feet. Clearly there are great opportunities offering for the further commercial development of this type of machine which can be so economical in upkeep.

About 1919 our finances were getting rather low, consequently we negotiated with several people as regards making suitable financial arrangements for carrying on the business. It ended in an exchange of Avro shares for those of Crossley Motors, Ltd., who were going to give us large orders for car bodies. Unfortunately as soon as the deal went through a motor slump started and Crossley's shares fell from about

33s. to 1s. 6d. in the course of a few years. Then in 1928 Crossley's, myself, and the other Avro shareholders sold their shares to Mr. John Siddeley (now Lord Kenilworth) representing the Siddeley group. I severed my connection with A. V. Roe & Co., Ltd. Then with my old friend and associate, John Lord, we acquired a controlling interest in another old-established British firm : S. E. Saunders, of East Cowes, Isle of Wight. The new firm was renamed Saunders-Roe, Ltd., usually abbreviated into Saro, and we at once instituted a vigorous policy of development. At the present time I occupy the position of president of the company.

Mr. Saunders, having been a designer and builder of motor boats for fifty years or more, and as both Lord and myself were great believers in the flying-boat type of machine it was natural that we should turn our attention to this type of aircraft. Our three principal types have been the *Cutty Sark* which has two 130 h.p. 'Cirrus' engines. This machine has been used extensively by Air Services Training. Then there is the 'Saro Windover' with three 130 h.p. 'Cirrus' engines, and there is the 'Saro Cloud' with two 160 h.p. 'Siddeley' engines. This last type is used both for private purposes and for training purposes in the Royal Naval Air Service.

One of the advantages of the amphibian 'Saro Cloud' is its ease of handling. At Calshot it used to take a large number of men a considerable time to take their flying-boats into or out of the water, but with our machine it is possible to get one from the tarmac into the water, flying same and return to its starting-point all within five minutes. The reason for this saving in time is due to the quickness that the amphibian under-carriage possesses in its ability to be raised or lowered.

Another branch of our firm is concerned with

building power boats. We have recently renamed this part of our business 'Saunders Shipyard.' We built the world's record motor boats both for the late Sir Henry Segrave and for Sir Malcolm Campbell. In Sir Henry Segrave's boat the propeller revolutions were as high as 20,000 per minute. In Sir Malcolm Campbell's there were only 6000. We can build boats up to 100 tons at our works which lie half a mile up the Medina river from the aircraft works.

About another mile farther up the river we have yet another factory, 'Saro Laminated Wood Products, Ltd.' We supply from this factory most of the plywood requirements for the aircraft industry. We also have an up-to-date plant for making panelling and flush doors. We manufacture many thousands of the latter, and some of them are beautifully finished in various kinds of fancy-grain hardwoods.

CHAPTER NINE

'*AVRO* 504'

I FEEL that a fairly full account of the 'Avro 504's' history should be given in view of the fact that this machine has been so extensively used all over the world, perhaps being to the aircraft industry what Henry Ford's famous Model 'T' was to the motor-car industry. This, too, in spite of the modifications, improvements and disimprovements it laboured under from 1913 to 1931. The new metal version of the 'Avro' which has been introduced since I sold my interest in A. V. Roe and Company, Ltd., is very similar to the old '504' in appearance.

When the '504' was introduced in 1913 the appearance and general efficiency were excellent with comparatively small horse power, but officialdom insisted on a number of modifications with the result that its efficiency fell off considerably. So an order went forth to scrap these modifications and revert to the original machine. However, this did not last long as heavier and more powerful engines had to be installed which necessitated strengthening certain parts.

I think I ought to point out, in view of the fact that various people have been mentioned as being responsible for this machine's design, that I not only drew the original general arrangements, the plans of which I have in my safe at home, but practically all the details.

The unit construction seating arrangement, control, joystick, rudder-bar, the original central skid undercarriage were all planned by myself. The under-

carriage was strongly criticized at the time of its introduction for its spidery, weak appearance. Actually it was very strong, and in the case of a pancake landing the two wheels took the first part of the shock, then the central skid would absorb a certain amount by bending between its supports, and then again the ground would generally give a bit. Loads were centralized on to the 'V' under-frame saving twists with their severe concentrated local stresses. Should this machine land on one side, the wheel on that side would take the first part of the shock, then the central skid, as just previously explained, would do the rest.

I had seen machines turn over in long grass due to the grass lashing over the axle, but in the '504' the central skid with the bracing-wires to the axle prevented this happening. Then again the upturned front end of the skid protected the propeller and permitted the machine to be as low as possible, otherwise the front part would have to be raised, making the machine inclined to be gawky and top-heavy. The rear end of the skid acted as a powerful brake due to the leverage of the fuselage.

I always carried pencil and paper with me (I do so still), so when travelling by train or waiting anywhere I used to work out sketch plans aimed at perfecting some part of the machine. If one looks at the various parts they will see how these have been designed to use the minimum amount of material and yet give great strength; unnecessary weight and cost of production was also carefully studied.

We had to employ a large drawing-office staff during and after the War, making drawings of this machine, etc. The Government also had a large drawing-office staff engaged on the various 'Avro 504' editions. The '504K' was, perhaps, the type in most frequent use. These Government staffs were situated at the Hotel Cecil which had been taken

over by the Air Ministry, and it was popularly known as the 'Hotel Bolo.'

The appreciation which the late Richard Gates gave to the '504' before the War, regarding its value was not accepted immediately by the Government, even when war had broken out. Early training in the Royal Flying Corps was done on no special machines, nor was there any fixed system of tuition. Each instructor had his own methods of teaching pupils how to fly, and when an embryo pilot changed instructors, then he usually had to change his methods of learning.

It was not until the School of Special Flying was organized at Gosport in 1915 that the 'Avro 504' became recognized as the main training machine for the Royal Flying Corps.

The Gosport system of training was largely organized common sense. It was the adoption of systematic methods of instruction. There was a grading of instructors for it was found that a good flyer did not necessarily mean he was also a good instructor.

But in a matter of discussing the close relationship which existed between the Gosport training system and the 'Avro 504,' I think I cannot do better than give the views of Mr. R. Smith-Barry (then Lieutenant-Colonel), who was in command. He has kindly written for this book a short vivid account of his views on our machine.

'The success of the so-called "Gosport" System,' he writes, 'was owing not so much to all the wise things we tried to do as to the large number of stupid things which we were careful not to do.

'There is a saying of the Chinese teacher, Lao Tsu, to the effect that the importance of a great many things lies not so much in what they are as in what they are not. For instance, he says, the chief thing about a bottle is the hollow place inside, and what distinguishes a needle is the hole at the top.

'Thus we did not keep on telling our pupils what a pity it would be if they collided with each other, this not being necessary as they one and all had an instinctive dislike of collisions which did not need to be intensified. Nor did we tell them that it was a terrible affair to return to their quarters after midnight as it really did not signify when they returned as long as they managed to be fairly sensible in the morning. If we had not made things interesting enough for them to want to be that, the fault was ours, not theirs. I do not mean to say that we could not be savage on occasion. We sometimes felt it our duty to work ourselves up to great extremes of savagery. Ours was not a Montessori school, at any rate not in every respect. But in this side of the question Sir Alliott would, I think, not be interested, as on the few occasions that I have had the pleasure of meeting him, I seem to have noticed that he was a character made up of nothing but geniality and sunshine.

'This being so, we wanted an aeroplane to match. Our methods came direct from Nature. They were not patched-up and "improved" copies of someone else's for we felt that as long as we continued to learn from Nature and refused to take ideas from any other source we should not be likely to make any great mistakes.

'We started with a varied assortment of aeroplanes, into all of which we fitted dual control. Neither the "Avro 504" nor any of the others were specifically intended for training purposes, and I still find it hard to say why this machine was picked on or why when one of us went to the United States in order to start a school over there, although we tried every machine they had to offer, nothing was found that was nearly as suitable as the "Avro."

'Perhaps it was because this machine was perfect

in all the negative qualities. For mere teaching its positive qualities did not interest us. For training, what we wanted was a machine with the negative virtues—controllability at all speeds, no "flat places" in its controls. Something, in fact, that gave you the feeling of a well-trained thoroughbred—that never broke in the air. It had nothing unnecessary about it, and it was easy to maintain. In fact, if anything did go wrong it was never IT that was to blame. A man who flies a "504" perfectly, merely tries any other machine and notes the many faults it may have in comparison with this machine, which is aero-dynamically faultless.

'Thus all the other machines had some awkward features that made them difficult to teach on, generally, insufficient lateral control. They were certainly not all copies, yet they felt as though they were made by men who had learnt their trade indeed, but who would have been just as good at any other. Certain it is that the "Avro" is the only tractor biplane in which the writer has felt perfectly safe *under all conditions*. For instance, it was then thought necessary to train pupils to do forced landings, the instructor never touching the controls unless compelled to do so in order to save an accident. I should certainly have had to interfere sooner and oftener in a "Curtiss," for instance, than on an "Avro," yet the "Curtiss" of that period was a slower and less ambitious machine and had nothing the matter with it. The long and short of it is that if you had an accident with an "Avro" it could only be by your own fault, and the same could not be said of any other tractor biplane that I tried.

'I have noticed that a thing is generally done best by the people that invented it. Get in an English railway train after a foreign one and the difference is at once noticed. It goes faster with less fuss and

noise. The best printing is still done by Germany where it was invented. Then the philosophy of mass production is best carried out in the United States. The fact is that the first original inventor of a thing generally has something at his disposal which his copyists have not—to wit, genius. A man of genius has not got to think very much. He will just do the thing right first time by instinct. The base copyist who comes along later feels he must change something or other in order to show his originality and, of course, makes a mess of things.

'I can think of many modifications which foolish persons thought it necessary to make to the "504."

'There was the man who must give it a tail fin for fear it would spin, although nothing but gross mismanagement or deliberate intention could make it do so. Then there were others who could not do with the under-carriage, which was the best thing about the machine and which actually included a delightfully simple brake years before brakes were thought of. They must needs pull it off and put something of their own, which was, of course, never nearly so good as they had not a genius for aeroplanes. Generally speaking, the "Avro" got steadily worse, a little worse every year by reason of the additions and alterations and exigencies of authoritative fools. Mr. Roe produced a perfect aeroplane long before the War. When it was first designed, the "504" was the fastest and most efficient machine in the world and years ahead of its contemporaries. By the end of the War it was an awkward copy of itself.

'If we had had a fleet of these "Avros" with 90 h.p. "Le Rhone" engines, which I am almost sure were also invented and available—at the beginning of the War, there's no saying what we could have done.

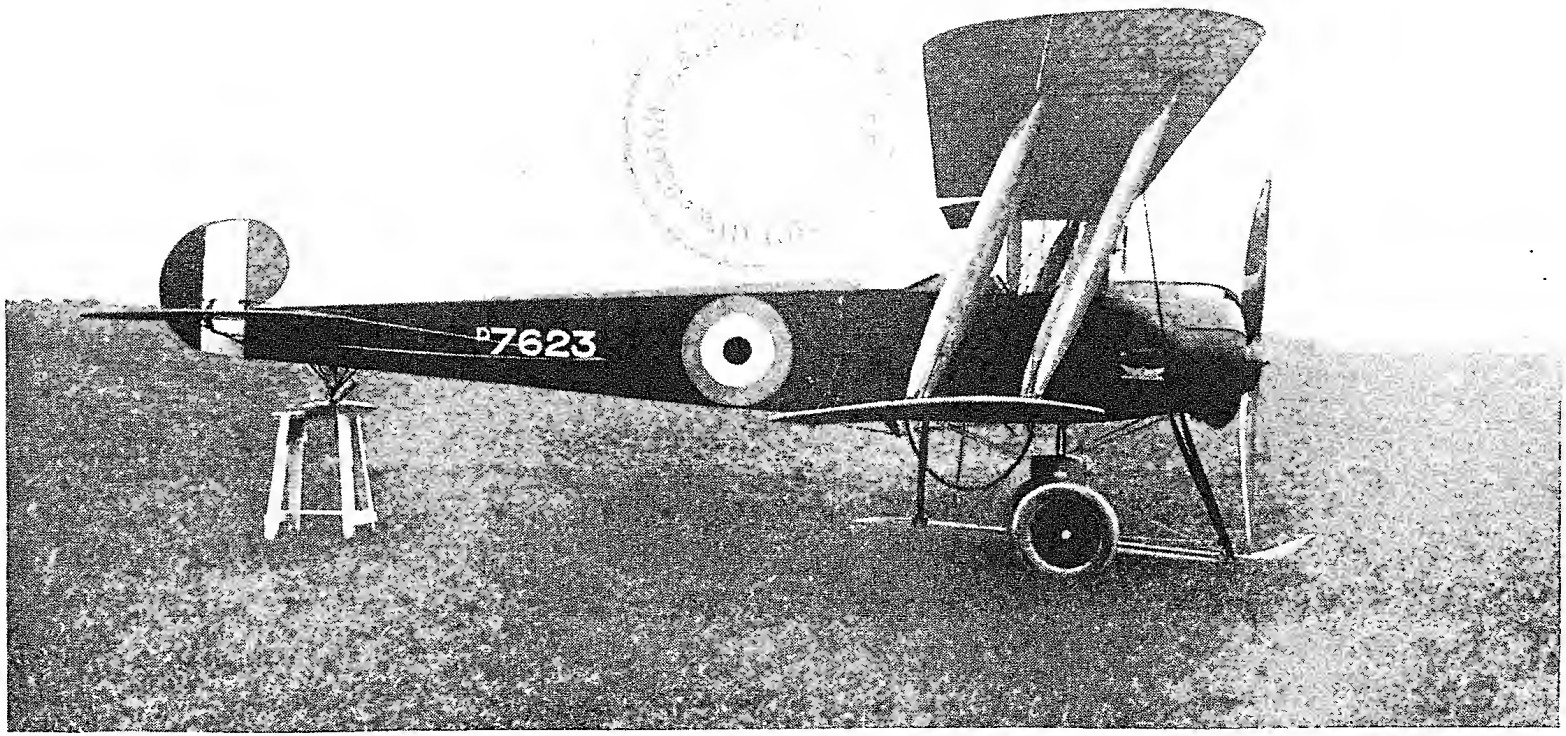
'It is a curious thing, but though after it had become out-of-date as a fighting machine, Gosport was the chief user and apostles of the "Avro" in later days. Gosport was, however, never consulted as to these modifications, and sometimes I wonder whether the designer was consulted either. (It used to pain me to see the dear old "504" being dis-improved by officialdom. I remember on one occasion appealing to a high official at the Air Ministry. He agreed with me that they ought to let me have the final say over the particular point in question, which meant increasing the weight un-necessarily. When I called at the Air Ministry to see him later as regards the matter, he said that he had consulted them, but they could talk the hind leg off a donkey, and suggested that I let the matter drop as it was not at all likely that they would let me have my way. A. V.-R.)

'Yes. It was because there was genius in Mr. Roe's productions that they were different to and better than all their rivals. Mr. Roe's designs came direct from Nature who also designed her sea-gulls and swallows. Consequently anyone flying an "Avro" is no more aware of his wings than a bird is.'

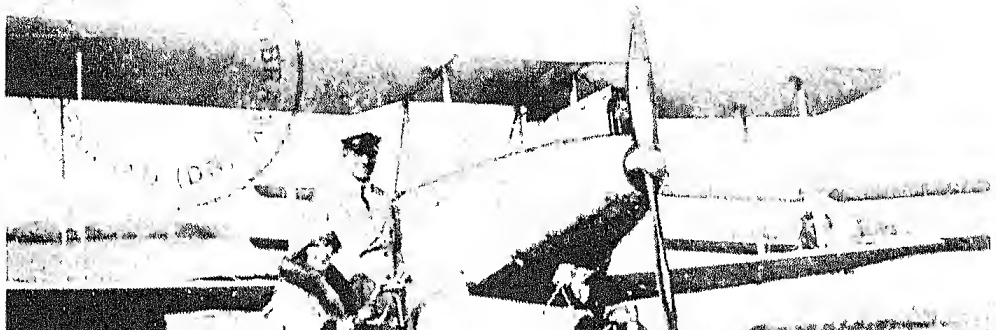
. . . . .

At this point I would like to take the opportunity of publicly thanking Smith-Barry—he will not allow me to call him Lieutenant-Colonel—for bringing to the notice of the powers that be, the suitability of the 'Avro 504' for training purposes. If it had not been for him it is very doubtful that this machine would have had an extended life, in fact, it might have been rendered extinct through being displaced by an inferior product of some influential constructor.

A number of officers said to me when I visited the

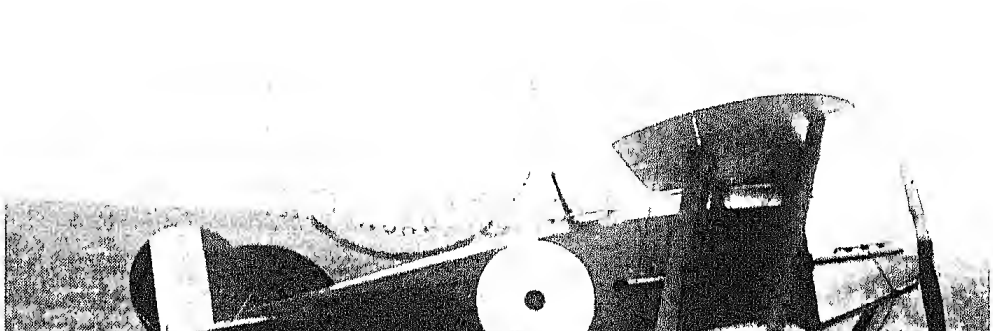


'AVRO 504 K'



THE 'SARO' RUNABOUT WITH THE HON. MRS. VICTOR BRUCE AND A. V-R.

Wheels held only on one side, all chassis well below centre line of wheels.



'AVRO' TWO-SEATER BUILT DURING THE WAR

Front during the War, and since, that had they had the 'Avro 504' instead of the Government-designed 'B.E.'s' in the early stages of the War, it would have made a big difference. To what extent it was difficult to foresee, in any case they considered many British lives would have been saved.

During the War the French Air Force sent a special Mission to Gosport to study their system. Following this, an 'Avro' was sent to every flying school in France to demonstrate the system by British flying officers. The French were so impressed that they gave big orders for the machine and licences were issued to allow its being manufactured in France. When the United States came into the War their Air Force also had demonstrations of the Gosport system, and their officers likewise were so impressed with the result that the American Air Force placed orders for several hundreds of our machines.

By the end of the War the 'Avro 504' had become the standard training machine throughout the British Empire and also in many foreign countries. With the coming of peace and for years afterwards the same machine was used for joy-riding concerns in every part of the world, and it proved to be the foundation of many commercial operating companies. During the General Strike of 1924 many '504's' were used by the Government in maintaining essential mail services.

Even to-day, in spite of advanced designs, it is considered to be the best machine for towing advertising banners over towns and cities. Not that this is a use of which I necessarily approve.

Some little time back there appeared in *The Aeroplane* an article by the Right Honourable the Earl of Cardigan in which he described his use of the 'Avro 504' as a private owner's craft. His account of personal experience with one of these machines seemed to me so interesting that I got in touch with

him, asking for his permission (which he most kindly gave) to reprint part of his views. He also informed me that his machine served him well in another respect for, he wrote, 'after using it for two years, I sold it at a large profit—I think 66 per cent increase on what I had paid for it!'

Here are some of the Earl of Cardigan's views on his experiences with a '504':

'The "504 Avro" *is*, in my humble opinion, a most admirable machine for the private owner's use. Indeed, I do not know that I need to express my opinion with this feigned humility. So far as I am aware, I am the only individual in the country who keeps a "504" for purely personal purposes. This distinction—if it is one—should justify me in giving my views with some boldness.

'I should perhaps explain that I bought my "504" with a particular object in mind. I had come to the conclusion that flying was not much fun if one had continually to be motoring to and from one's local aerodrome. I had determined to get a machine which I could keep, as it were, "on the premises."

'The "premises," in my case, consisted of one fairly large field, sloping, with a bad approach on one side, and commonly infested with cows. In the adjoining meadow was a barn. I converted the barn into a make-shift hangar, laid down a few yards of tarmac in front, made a breach in the hedge between meadow and field, and so formed the nucleus of a private landing ground.

'Now, I was under no illusions about my own proficiency as an airman. I therefore required a machine which would lend itself readily to these rough-and-ready conditions. Someone at the vital moment brought along an "Avro" for me to look

at. I saw it make one or two landings in my field—utilizing about a tenth of the space available—and instantly decided that this was the very thing for my purpose. Hence the transference of G—ACZC from R.A.F. surplus stock into private ownership.

'When it came to flying my own "Avro," my first impression was of its perfectly enormous size. The "504" is, as most people know, a biplane with non-folding wings, a span of 36 feet and an overall height at the wing tips of 10½ feet. It has a very great number of inter-plane struts, and more bracing wires than one would believe possible. It has been well said that to glance from the front cockpit along the wings is "like looking down the aisles of some great cathedral." One is impressed—and a little awed.

'All these struts and bracings, however, have certain implications which are comforting. It is abundantly clear that the makers, when they designed the "504," were determined that under no circumstances should the machine, or any part of it, disintegrate. When in doubt, they fitted an extra wire or two—and there is no doubt that this "Avro" is of tremendous strength and inherent sturdiness. Only by gross misuse is it ever likely to be damaged.

'Thus, in the first place, the "504 Avro" has the virtue of inspiring its owner with a very pleasant sense of confidence. The front cockpit, from which the machine is flown, has far more than the ordinary amount of elbow-room—and this again is helpful. No beginner is likely to fly well when he feels himself "cribbed, cabined, and confined."

'As soon as he begins to start up the engine, the "Avro" owner comes upon a whole crop of further good qualities. For example, there is a hand magneto—and I would suggest that, to anyone who has become accustomed to this simple starting

device, the old system of swinging the propeller must seem inconceivably barbarous.

'To illustrate this—If I land in a field with the ordinary light aeroplane, I must restart the engine unaided, standing the while dangerously near to the "live" airscrew, and dangerously remote from the controls and switches. With the "Avro," I can safely ask any yokel to wind the engine round for the purpose of "sucking in," while I myself remain in the cockpit. All switches are "off," and are not set to "contact" until I see that my assistant is standing well clear of possible trouble.

'Is this a trivial advantage? To me, it seems to be an enormous boon.

'Then again, before starting, one likes to be assured that one has ample petrol for the intended flight. This "Avro" has, in my opinion, the best form of petrol-gauge ever invented. It has two tanks, and to each tank a tube of clear glass is affixed. In each tube one can see, not a float which may stick, but the actual petrol itself. An immutable natural law decrees that the level of the petrol in the tube must be exactly that of the petrol in the adjoining tank. The evidence, therefore, is direct—not merely circumstantial.

'Various engines may be fitted to the "504." In my case, it is a "Siddeley Lynx," and this well-known 7-cylinder radial unit develops 200 and odd h.p. Thus my machine is very amply powered, has what seems to be an adequate turn of speed, and will take off with almost any load from any surface.

'For economy, I am normally content with 80 m.p.h. (1500 r.p.m.), but I can get 90 m.p.h. at normal cruising speed and about 100 m.p.h. as a maximum.

'If these figures seem poor to the conventionally

minded airman, remember that many of my journeys are made literally from door to door. I can take off from a point 500 yards distant from my house, and quite commonly land within 500 yards of my destination. Thus my all-in average speed is very high.

'The take-off, as I have mentioned, is exceedingly quick. The "Avro" becomes air-borne at less than 40 m.p.h. Often, when taking off from a rough field, I have felt the wheels hit a rut or ridge within the first few yards. The machine has been thrown into the air, and has astonished me by starting to fly without any further ado.

'At other times I have had to take off from my field when a heavy crop of hay is being grown. This is not quite so easy, because the straight axle of the under-carriage naturally meets with stiff resistance. But with a little extra run the machine will lift a full load, even in these conditions.

. . . . .

'In landing a "504" many good features become evident. The pilot's forward view is excellent, partly owing to the steep angle of glide. For the same reason it should always be easy, in any wind at all, to make an adequate good approach. With most aircraft, one can either over-shoot or under-shoot. With the "Avro" one can only under-shoot.

'This, to a beginner, is a great comfort. If he will only remember to come in fairly high, he cannot fail to finish up somewhere in the middle of the field. If he comes in with exaggerated height, only a very little side-slipping is needed to correct this. To over-shoot grossly or irreparably is well-nigh an impossibility.

'Then again, this machine will glide much more slowly than most, while still remaining quite safely controllable. This is a very real asset, parti-

cularly when, as happens when one is flying from field to field, there is a certain amount of cow-dodging to be done. The pilot approaching the ground at a quiet, steady speed can keep every cow under observation, while virtually allowing the machine to land itself.

'Incidentally, here is one of the drawbacks to flying an "Avro." However good a landing he does, the pilot will never be allowed to take any credit for it. His most superlative effort will always be greeted, by the *cognoscenti*, with the stock comment: "Of course, these old buses practically land themselves." It can be a little disheartening.

'In truth, the under-carriage is exceptional in its ability to absorb shocks—so much so that a "504" would probably *not* be a good machine on which to learn landings in the first instance. I myself have frequently made landings which I have known to be indifferent, or even downright bad, only to be thanked or congratulated by my passengers for having put them down so gently. The "Avro" pilot must studiously preserve his own standard of what is good and what is bad in this connection.

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'It is practically impossible for this machine to be overloaded. In my case, there is a double cockpit behind, containing two passenger seats, of which one can be removed when not required. When only one passenger is carried there is room for any quantity of baggage. Several good large suit-cases can be piled in, and the effect upon the machine's trim and performance is quite negligible.

. . . . .

'In reliability, handiness, safety, and capacity for sheer hard work it can still hold its own—and more—with any of the modern light aircraft.'

CHAPTER TEN

THE FIRM OF A. V. ROE & COMPANY, LTD.

HAVING now told the story of my own life up to the present day, I feel I would like to tell of some of my interests and activities in greater detail. I will commence by relating the story of the creation and growth of the large aircraft firm which bears my name—A. V. Roe & Company, Ltd. It is true that for over ten years now I have given up my business connection with this firm, but I still retain a strong sentimental interest in its productions and its success.

The firm of A. V. Roe & Co., Ltd., celebrated its Silver Jubilee on 11 January 1938 as the original company was registered on 11 January 1913 by my brother 'H. V.,' Mr. James Grimble Groves, a member of the big brewing firm in Manchester, and myself.

The building-up of the firm is a story which, I think, is of interest, for from the smallest and humblest beginnings it has now grown to be one of the biggest aeroplane-producing concerns in the British Empire, employing at the present time thousands of men, and with most extensive plant representing an investment running into millions of pounds.

Few big businesses become so ready-made. Almost invariably they have grown from the germ of an idea, and it is fortunate that this is so, for it indicates to other young inventors what can be done with ideas in which they strongly believe.

There is one point I wish to emphasize. It is that if I had been a spendthrift there would never have

come into existence this firm. It was only because I saved and saved that I was able to bring the business into creation. I certainly received financial help from both my father and brother in the very early days, but every penny went into the work I was doing. Compared by any ordinary standards it is clear, I think, that the total amount which my early experiments did cost was astoundingly small. I used to work and save, and then I spent what I had saved on further work and inventing.

I have already mentioned how in 1909 I had come to the end of my own financial resources. It was then my brother first came to my assistance. He records that it was on 27 April 1909 that we actually became partners, for in his cash-book of that date he made the entry: 'Cash to clinch our agreement, £1.'

At that time I was at Wembley, and our intention, at first, was to get some third party to join us and finance my experiments.

With this end in view my brother sounded various likely persons. One of these was that enterprising man, Captain Windham, who was then building motor-car bodies in a workshop at Clapham Junction, with the help of premium apprentices. He had also gone in for certain flying experiments, having built a strange-looking monoplane which had appeared at the Doncaster Flying Meeting. It was fitted with a weird-looking propeller having blades that were shaped like half-moons. The machine, however, never flew, as it collapsed, to the great amusement of the onlookers, whilst Captain Windham was sitting in it waiting to be photographed. Later in 1911 Captain Windham was connected with the organization of the first official aerial postal service in Europe, when special post cards and letters were carried between London and Windsor. Some years later he married the widowed mother of Lieutenant-Commander Glen Kidston, who was later

killed in South Africa in a flying accident. To-day Captain Windham is Sir Walter Windham, and he was for some years a Member of Parliament.

We had certain discussions with him about his taking a financial interest in our proposed young firm, but he decided finally not to do so.

We next approached Colonel Mulliner, the head of the great carriage-building firm, and after he had turned the idea down we went to see Lieutenant-Commander Kenworthy (now Lord Strabolgi), who had been watching me experimenting.

He and his brother became interested and decided to put £1000 into our business. This sum was paid over to us. But Kenworthy's mother, for some reason or other, most probably thinking the money would be lost, did not want this money invested in such a way, so happening to be in Brighton where my father was also staying, she called on him and said she would like to have this money back. My father said he would gladly agree, and sitting down wrote out a cheque for the sum right away. This was the last of our attempts at that time to try and interest outside capital.

At last on 1 January 1910 my brother made a New Year's resolution that instead of wasting a great deal of time, without any result, in trying to get other people interested in our project, he would find the money himself.

My brother, who had a financial mind, put it on record that up to the date of his New Year's resolution my father, Dr. Roe, had lent me £299 15s., whilst he himself had lent me £141 4s. 4d. This commercial accuracy was to prove of great value to the young firm.

The agreement I made with my brother was very simple, and it was not in writing. We arranged that if things turned out well we would go halves over the profits, but if they failed, then I was to be regarded

as being free of any liability, and my brother would undertake to pay all the debts. In return I undertook to look after the design and construction of the machines. He held himself responsible for the finance, organization, and management. Before the business was a final success, it is interesting to record that his investment in the firm came to about £10,000.

At the beginning of our partnership the firm built its earliest machines at Everard's works at the Brownsfield Mills in Manchester. These were the machines which appeared at the Blackpool Meeting and at Brooklands during 1910. At that time it was the triplane which interested me and we continued with this type until 1911.

During this early period it was a case of money going out and very little coming in. Certainly we made no profits. It was not until 1912 that we first began to see daylight financially. It was in that year that we went over to the building of tractor biplanes. In the summer of 1912, despite opposition from the Royal Aircraft Factory at Farnborough, we were given an order for a dozen of our biplanes which were equipped with 50 h.p. 'Gnome' engines. C. G. Grey, writing in *The Aeroplane*, described these machines at that time as being 'as good an aeroplane as anything in the world.'

I have often been asked why our most famous production should have been given the number '504.' The answer and explanation is simple. When we first built our biplanes we felt that we ought to give them some official number or designation so as to indicate the types. As is so often the case in the early start of businesses, we had previously not worried about the matter, and we kept no particular count of the experimental machines we were producing. When the time arrived when we took the matter up seriously we agreed that a 'respectable' number such as '500,

seemed far more impressive than merely Number One. So we called our first enclosed monoplane Number '500.' The enclosed biplane which was the machine we entered for the Military Trials was Number '501.'

The various activities in which we came to be engaged made our firm look as if it were really getting into business, with the result that my brother and myself decided we should convert it into a limited liability company. Our first step after doing so was to move our workshops from Brownsfield Mills to more commodious premises in Clifton Street, Miles Platting, Manchester.

Up to this time my brother had been looking after both the brace-making business of Everard and Company, and also A. V. Roe and Company. But it was now decided to separate completely the two businesses, for he did not wish Everard's to fail should the other business not succeed. With this end in view he took in his manager John Lord as a partner, and so from January, 1913, H. V. left John Lord more or less free to develop the Everard & Co. business as he thought best. Thus enabling H. V. to devote the whole of his time to the aeroplane business. When my brother left A. V. Roe & Company, Ltd., in 1917, he offered his remaining interest in Everard's to John Lord, who then became its sole proprietor.

I would like to say a few words here about John Lord who became a director of A. V. Roe & Company, Ltd., soon after H. V. retired. He was a typical Lancashire man with an unfailing good humour and an equally unfailing stock of funny stories. Some of these were unpublishable, but most had that sound north-country philosophy of life about them, and John's native Lancashire accent was perfect when telling some of these stories. Everyone loved John, and I do not think he had an enemy in the world. Yet in spite of this he was

certainly not 'soft,' and he was a shrewd business man. Even the Contracts Department of the Air Ministry found they had to deal with an extremely clever bargainer.

John Lord held various official posts in the Society of British Aircraft Constructors which showed that he was liked and respected by the other manufacturers. Few persons in the aircraft industry have been so sincerely mourned as he was when he died on 25 January 1936.

It happened that towards the end of 1912 'H. V.' had invited the members of the Manchester Aero Club, which did not then fly, and had nothing to fly on, to visit our works. Among the visitors was a young man, Piers Groves, who later did good work in the Royal Naval Air Service. He took a liking to my brother, and told his father that our new business was worth looking into. As a result Mr. Groves came along and after going into the matter thoroughly decided to join us when the new firm was registered. He also agreed to put up the extra cash which was needed in order that we might develop the firm properly.

In the new firm both my brother and myself took all our payment in shares. James Groves suggested, indeed, that my brother ought to be given something in cash because of the way in which Everard's had financed the business, but he replied that as he thought the new business to be a sound proposition, he was quite prepared to stand by his former promise. The Groves family took 10 per cent cumulative participating preference shares, and my brother and myself took our payment in ordinary shares which were to receive two-thirds of the remaining profit, if any, after the interest on the preference shares had been met.

James Groves, who became our first chairman, was a splendid man, and his early death was a great loss

to the company. He was most popular in the Manchester district.

It is interesting to mention that our first chairman was also the father of R. M. Groves, one of the best officers the Navy ever allowed to go into the Royal Naval Air Service. He was killed flying in Egypt where he was an Air Commodore in the Royal Air Force, after the War. Then a daughter of Mr. Groves is the wife of Air Vice-Marshal F. C. Halahan. Thus the Groves family as a whole have been closely identified with the development of flying from the early days.

R. J. Parrott, who had come to me as my first draughtsman, was with us through all the strenuous years both of early development and throughout the War and after. He became in due course the general manager.

Then there was Roy Chadwick, who joined me as personal assistant towards the end of 1911. He came straight from school to the drawing office where he quickly showed his aptitude for design work. To-day he is the chief designer of the firm. He has shared, and also disputed, my views on design since he joined us. In 1914 he became our chief draughtsman, and was officially appointed chief designer just after the War. Thus he has been responsible for all the 'Avro' machines since then, and has pioneered many original conceptions. Amongst these are included the little 'Avro' baby, the first successful light aeroplane, and the 'Ava' of 1923, which was the largest all-steel aeroplane built up to that time. He also designed some of the first stressed-skin aeroplanes to be built in Britain, such as the 'Avocet' and the 'Antelope.' In recent times Roy Chadwick designed the 'Anson' which was the first machine of the modern formula (low-wing, twin-engined monoplane with retractable under-carriage) to go into quantity production for the Royal Air Force.

When he first came to us Roy Chadwick did quite an amount of flying as an observer in 'Avro' machines when they were being flown by F. P. Raynham, who undertook much of our experimental and test work. Later he thought he should learn to fly himself and tried. But his attempt landed him in hospital after a bad accident. It proved to him that he might be an excellent designer, but an unfortunate pilot—a fact which has often been proved by others.

Then there is R. H. Dobson, who joined the firm in August 1914, and by the end of 1918 had become assistant works manager. Shortly afterwards he was appointed works manager, and about four years ago became general manager, and has later still joined the Board of Directors. It would be difficult to reckon the number of aeroplanes which he has been responsible for in production. It must have run into many thousands, but he is a man who has proved that he is never afraid of tackling difficulties when they come along.

Finally, in paying my tribute to those men who have been so closely connected with our firm in the creation of 'Avro' machines I would like to add the name of H. E. Broadsmith. He was also one of the early staff. He came to us after having had experience as a marine engineer, and joined our drawing office. After the end of the War he went out to Australia to superintend the building of 'Avros' there. When the slump took place in Australia he returned to England again, and joined us at Saunders-Roe.

The importance of a capable and loyal staff cannot be over-estimated, and I am glad to say that at our old firm and now at Saunders-Roe we have always had working with us men who have proved to be of the highest calibre. There are others who have also done splendid work.

During the War we had to make continual extensions

of our works, and so great was the demand for the 'Avro 504' as a training machine, that the timber question became serious. Lord Weir, speaking at a public dinner, stated that we were using one-third of the total supply of aeroplane timber, and that this total demanded the labour of 15,000 lumbermen. It was this shortage of timber which brought about the use of metal instead of wood in aeroplane construction.

All the 'Avro 504' output did not come from our own factories, for it was quite impossible for us to cope with the huge demand that the Royal Air Force made on us. It was arranged, therefore, that they should be built under sub-contract by other firms in the country. I have referred to this matter in a previous chapter. I might mention here that at our Manchester works we were turning out over sixty of this one type alone each month.

On 31 July 1917 my brother, who was managing-director of our growing concern, decided to retire from the business. At the beginning of the War he had been recommissioned to his old regiment, and had been told to report to the Military authorities at Wool, in Dorset. But before he had time to do so he was told by the War Office that his services were considered to be far more valuable in the aircraft industry, so he gave up the idea of the Army for the time being. Still, as an old soldier he had a constant hankering for more active military service, and when he saw that he could leave the firm in capable hands, he decided that he would try and get on active service.

When he left the firm he was over forty years of age, and the doctors at first would not take him for the Army. But after several tries he managed to pass and was told to report at the School of Military Aeronautics at Reading.

When he passed through his initial training there he found that the Royal Flying Corps would not take him

as a pilot, so they made him an observer and sent him out to France to join the Independent Force which was under the command of Lord Trenchard, and which was then operating in the East of France. His job was the unpleasant one of sitting in the nose of an 'F. E. 2D' machine with a Rolls-Royce 'Eagle' engine behind him and his pilot, while they flew over the Vosges to bomb German towns and military centres. His War service ended in a 'crash' in the dark, while his machine was landing. He got off with a fractured astragalus which brought him to hospital at Hampstead.

Shortly after the War he married Dr. Marie Stopes, who besides being an authority on sociology is also a Doctor of Science and one of the world's leading authorities on coal. They and their son live to-day at Norbury Park, between Dorking and Leatherhead.

To return, however, to the activities of our firm. As the War continued it became obvious that we would require much larger works in order to maintain the output of 'Avro' trainers. Fortunately or unfortunately, Mather and Platt had just completed a huge new extension to their works which lay close to our own factory. As they did not think they would want these new premises we arranged to rent them from the firm. I did not care for the idea of being in a rented works. Also I did not like the position of having our works in Manchester. I thought that the Navy would more or less go into the air and that flying-boats would be used extensively for linking up the Empire; I conceived the idea of establishing modern new works and a garden city of our own for the employees somewhere on the south coast of England where we could build aeroplanes or flying-boats, or both, according to their demand, and our employees could breathe God's fresh air.

So my wife and I motored round the Southampton

district, and as soon as I saw the very large field at Hamble on Southampton Water, I said: "This is our spot." I wired for one of my co-directors to come down and see it. Within a fortnight we had bought the field and a mile of foreshore, well over a hundred acres in all; subsequently we bought a further two hundred acres. This area to-day is the Hamble Aerodrome of Air Service Training, Ltd.

We commissioned the services of Mr. Harry Fairhurst, the well-known Manchester architect and artist, to design the Hamble works and garden city, or rather, village, containing some 350 artistic houses. We only got as far as building twenty-four of these and then had to give up the idea of the scheme at Hamble, as all available building material was required for Government projects. So we had to be satisfied with using Hamble as an experimental establishment.

This dream of mine failed to materialize, as others have done; but one gets a great thrill out of life by working for ideals, especially if they are for the benefit of mankind.

It was most desirable that we should have works of our own, so we decided to buy a piece of triangular-shaped land alongside the Mather and Platt extension that we were occupying. This land was bordered by the railway on one side and roads on the other two. The snag was that a valley stood in the centre and that many thousands of tons of earth would be required to fill it in. As a local tipping-ground was badly required we decided to buy the site, and for many weeks strings of carts and lorries were tipping earth and rubbish into the yawning chasm.

During the War our firm built close on ten thousand 'Avro 504' type machines whilst an equal number were built under licence by outside firms. In addition we built many other types of machines. These numbers will indicate how the small original firm

had grown. Yet it was only five years before that we used to welcome an order for even a single machine!

Then, as regards the staff. Prior to the War the total number employed was a mere handful of men. When I left the firm in 1928 we were employing close on five thousand. Now, with the Government's re-armament programme, great extensions have taken place and more than twelve thousand people are working for the firm of A. V. Roe & Company, Ltd.

It was in 1928 that I sold out my interests in my original firm. The business then came under the control of Sir W. G. Armstrong-Whitworth Aircraft, Ltd., the head of which was Sir John Siddeley, now Lord Kenilworth. In 1936 the Armstrong-Siddeley Development Corporation and all its subsidiaries, which included A. V. Roe & Co., Ltd., was absorbed by the still greater Hawker-Siddeley Aircraft Co., Ltd., and this group is one of the largest in the British aircraft industry. It includes in addition to the 'Avro' firm, Armstrong Whitworth Aircraft, Armstrong Siddeley Motors, the Gloster Aircraft Co., Ltd., the Hawker Company, and Air Service, Ltd., along with many other subsidiary concerns. But the whole business is thoroughly well-run and is a very important factor in our re-armament programme.

Mr. T. O. M. Sopwith is chairman of the company, and Fred Sigrist, another of the original pioneers at Brooklands, is another of the directors.

I would like to bring forward here a matter which is of considerable financial concern to inventors and the original builders of businesses. I feel that when companies are formed that in the Articles of Association it should be laid down that the original 'begetter' should be entitled to a very small fraction of the profits during their lifetime. Thus any company or syndicate buying such a firm would be under a small obligation to the original creator of the business

from which they would expect to make profits. The small size of the percentage would hardly affect them. In fact the greater the return to the original founder, the better it would clearly be for the shareholders. It so often happens that inventors and creators do not benefit to the extent that they should do.

I understand that the firm of A. V. Roe & Co., Ltd., still remains an entity as it was when originally formed in 1913, and it still has its original Articles of Association and the same capital. The shares have changed hands, but the company has never been refloated or refinanced.

On leaving A. V. Roe & Co., Ltd., I took over, along with John Lord, the firm of S. E. Saunders, Ltd., the famous boat-builders who had built the hull for the original Sopwith 'Bat' boat—the first British amphibian was quite an interesting effort. We changed name of the company to Saunders-Roe, Ltd., and its present productions are given the name of 'SARO.' The business has increased very considerably until to-day we employ about two thousand people. Our erecting-shop is considered to be possibly the finest flying-boat shed in the world. It has six overhead cranes. The door to the shed has 45 feet of clearance and is 150 feet wide.

CHAPTER ELEVEN

MEN, MACHINES, AND MEMORIES

FROM the time that I first interested myself in aviation I have, at one time or the other, come in contact with most of its leading and prominent figures. There are some persons in this world who, by reason of their peculiarities, charm, or other outstanding characteristics, fix themselves in one's memory far more strongly than others. The latter may have done distinguished and prominent work yet, in retrospect, one cannot remember anything of specific interest about which one can particularly write. But, in any case, considerations of space will only allow me to give a few memories of people and machines of the past. If I have omitted any person who thinks they should have been included, I hope I may be pardoned for such omission.

When I throw my mind back to the first well-known man I got to know, it brings a name which may cause amusement and surprise, for it was none other than the famous 'Buffalo Bill' who used to provide such great entertainment with his 'Wild West Show' to the youngsters (and also the grown-ups) of that era in which I was a boy.

My personal meetings with him took place whilst I was at St. Paul's School. At that time 'Buffalo Bill' —his real name was 'Colonel' Cody, but he was no relation to the other Cody who became famous for his pioneer flying exploits—used to carry on his show at Olympia, and later at the old Earl's Court Exhibi-

tion. I got into the way of going to Olympia on my way home from St. Paul's to help him paint the scenery which he used. He was a fine old man with a remarkable fund of stories of the old days in a real Wild West where he had been a famous hunter and scout. His tales of his experiences with the Red Indians had a flavour of romantic adventure for which there is no counterpart to-day. I took a great interest in helping him with his scenery painting, for I used to be fascinated by the broad splashes of bright colours which he used on his canvas backgrounds. When he had completed some particularly brilliant effort I used to stand back and watch it almost hypnotized with pleasure and excitement. There are no shows to-day which can compare with the entertainment this old man put up, for he impressed his own personality on the whole performance. Later when he died he was buried in a lonely spot in the mountains near Denver, where his spirit can look over those wide spaces of country which he was largely instrumental in taming. It was at Nichol's Castle, a few miles out of Denver, that I had my experiences with the 'Davidson' helicopter, which I have mentioned in an earlier chapter.

Of the other 'Colonel' Cody I have made several references previously. He, like his namesake, 'Buffalo Bill,' was an interesting and colourful personality. In his early days of flying experiments he had been interested in man-carrying kites, and had acquired a considerable reputation in this branch of aeronautics. Later he had worked with Colonel Capper, R.E., at the Balloon Factory at Farnborough when they were carrying out their early experiments with airships. They were responsible for the construction of the first British military airship—the *Nulli Secundus*—whose envelope was made of gold-beaters' skins, a rather expensive commodity. Each skin had to be joined

together at considerable cost and by hand-labour. Each skin only measured eight inches by thirty inches. About 1906 I wrote to Colonel Capper, saying I was very interested in building a full-size machine and asked if there was any vacancy on his establishment. He replied saying that there was none, nor was one likely to occur.

Later Cody went in for the construction of aeroplanes, and he almost alone of the early pioneers knew how to get on the right side of the authorities, who gave him valuable concessions. I was not an admirer of his design or construction, but he certainly got results which contributed towards the development of aviation. I thought he was lucky in that he did not meet with a fatal accident sooner than he did, for certain important bracing-wires on his machine were not duplicated which, of course, reduced the safety factor. He used rule-of-thumb methods like we all did in the early days, but Cody's machine, in addition, had a decidedly 'Wild West' appearance about it. On one occasion I pointed out to him, after he had made his first cross-country flight from Farnborough to Brooklands, that the wires to the outside top plane were not duplicated as they should have been.

"What would you do if one of them broke?" I inquired.

"I suppose my name would be mud," was his characteristic reply; but he took no steps to duplicate the wires.

Another pioneer whom I often used to see and whose name is not as well known as it should be, considering his services to our knowledge of flight, was the late José Weiss. He was a most charming man, a Swiss, I believe, by birth, but had lived in England for a number of years. He had, however, a very broken English accent and occupied a fascinating old cottage at Amberly. Weiss was a keen student of birds,

having constructed a large number of model gliders, based on their wing-form. On one occasion I went out on the Downs with him when he sent a model on gliding flights. They used to fly extraordinarily well. He entered a machine at the *Daily Mail* competition in which I gained my prize, but his model did not do well under power.

Some of Weiss's models were of considerable size ; he also constructed man-lifting gliders on which Gordon England used to glide. This glider was perfectly stable, and on it the pilot never lost his balance, no matter how gusty the wind might be. One of his gliders can be seen at the South Kensington Museum, and it should be carefully studied by those who are interested in the theory of flight. José Weiss was a great believer in the use of size and its generally improved efficiency over smaller-type machines. He has written a number of books dealing with his ideas on flight. These usually appeared in private editions, and they are greatly prized by collectors. Weiss certainly played an important part in the early development of aviation, and he had the capacity for taking infinite pains in all the practical work which he carried out.

Another of the 'old brigade' who I used to meet at times was the late Sir Hiram Maxim. I remember lunching with him one day, but some of the pleasure of his conversation was lost as the old man was very deaf which necessitated us both doing a great deal of shouting. Since deaf men generally talk rather loudly. After lunch he took me to his workshop which was remarkable for the very tidy and orderly arrangement of everything in it. "A place for everything and everything in its place," was a remark which he kept on reiterating to me. I also noticed that this slogan was prominently displayed on the walls.

Maxim was, of course, one of the pioneers of flight,

for he had made his first machine away back in 1894. His trouble at that time was the lack of a suitable light-powered engine. He was obliged to use a steam-engine which was far too heavy for his purpose. Despite this he showed, in his experiments, quite clearly that the machine he had constructed had the power to lift, although the machine would have been very unstable if it had been permitted to rise into the air.

Later in 1909 he built a very large machine which had a span of more than 40 feet. He employed a large number of workmen on his experiments, for he apparently had considerable capital, the result of his other inventions. His machine had three propellers, a small one fitted to the motor-shaft, and the other two on either side and about 25 feet apart. The engine he used was a petrol-motor with four cylinders, and weighed complete only 220 lb. I thought that the design of his propellers was interesting, but his machine lacked stable qualities. The engine, petrol-tank, and the pilot were considerably below the centre of sustentation. The machine was also far too heavy.

A highly interesting machine that made its appearance in the early days was one constructed by Captain J. W. Dunne, who carried out his experiments at Eastchurch. This was in 1909. His machine was tail-less, and Dunne had concentrated on the problem of stability. He had made his machine with the shape like a very broad 'V.' I thought it was an excellent idea and had, in fact, made some of my own models on similar lines. I have found that when aeroplane-wings have the merest sweep-back that extraordinary stability can be secured. Most experiments in this direction go wrong because there is too great a sweep-back of the wings. In this connection Captain Railton-Holden has produced an excellent model aeroplane (it is sold by most of the big stores)

which is designed on the lines I have just mentioned. In a span of just over a foot the sweep-back is only half an inch, but this secures for the model astonishing stability. I feel sure that there is much scope for investigation and experimenting in this direction. Apparently complete control can be obtained by the ailerons on this type of machine, so there is no need for rudder or fins. This would result in simplification and a reduction of weight and head resistance with a resulting increase in speed, with any given horse-power.

The question of fitting air brakes to the tail-less type of machine requires special consideration, maybe the ailerons could deal with the upsetting moments, since the ailerons can both be operated up or down together.

Much interesting information can be obtained from models. The tail-less type requires a wash-out on the wing tips and no vertical surfaces are needed. But if there is no wash-out, then a fuselage carrying a tail plane becomes necessary, also a vertical fin. If the fin is removed, the model spins and becomes hopelessly unstable.

The War Office in 1908 took an interest in the experiments which were being made by Dunne. These trials were carried out in Perthshire in a rather lonely spot with the result that considerable interest and excitement was aroused which started up a flood of rumours of mysterious happenings. Later the War Office decided to give up their interest, so Dunne induced Lord Tullibardine to form the Blair-Atholl Syndicate which then built another and larger machine. This was the machine which he brought to Eastchurch. At first Dunne had difficulty with his pilots for he could not get them to fly his machine properly. As a result, although he was a disabled man, Dunne decided to fly his machine himself and as he thought it should

be flown—that is to say with a certain amount of rashness, so that it would demonstrate clearly its automatic stability. He succeeded in doing so, although finally he had rather a bad 'smash' in landing.

There was another machine produced a few years ago which was designed on somewhat similar lines—the 'Hill'—which was tested at Farnborough, presumably it has not met with great success, otherwise one might have heard more of it. Judging from memory it would appear that there was too big a sweep-back of its wings.

In the early history of flying few men have played a more prominent part than Santos-Dumont, a wealthy Brazilian. I was especially interested in one of his machines which was first shown at the Aero Exhibition of Paris in 1909. It was the first of the small machines and it was a tiny monoplane which was often referred to as the 'bird-cage parasol.' This machine had a small wing span with a big camber, and the pilot sat in a kind of wire cage underneath the wings where he offered considerable resistance. I did not like the pilot being so exposed, but it was the idea of the small machine which made a great appeal to me. Santos-Dumont made some flights on this machine and he gave its designs free to the world. It was a cheap machine to construct, costing only a sum of about £200. It was able to rise from the ground very quickly. A Santos-Dumont machine made an appearance in England at the Bournemouth Flying Meeting in 1910, but it never became popular, for the machine was difficult to land owing to its very steep gliding angle.

This same pioneer who was the first man in Europe to make a free flight (which he accomplished in 1906) had, previous to the production of his 'baby' machine, made several machines of the 'canard' type. Their

construction was interesting. The main wings were of box-type with a covered square fuselage projecting forward and carrying another small form of box-kite construction which was pivoted at its centre. The whole conception was excellent. The engine was fitted in the rear of the fuselage, driving 'pusher' screws which revolved at the trailing edges of the main planes. Santos-Dumont had to stand in front of and close to the leading edge of the main planes.

Two other early pioneers whom I met were Farman and Blériot. The former was actually an Englishman although he lived and carried out his flying experiments in France. His early machines were, like those of Santos-Dumont, made with box-like construction of the main planes with a smaller box-kite behind and a single surface small plane in front. This front plane was used for rising and descending, and was pivoted. The tail plane was held rigid on four booms which were braced. Later Farman developed ailerons, being, I think, the first person to do so.

I met Farman at the Blackpool Meeting in 1909, where he was one of the leading figures, having made a great name for himself by his pioneer flights which attracted world-wide attention. He expressed astonishment at the lightness of my machine, which was very much lighter than his own.

Blériot I found to be a very charming man, and, incidentally, had a very pretty daughter, to whom he introduced me the last time we met. As, however, he spoke no English and I cannot speak French, it made things difficult in carrying on a conversation, even with the assistance of an interpreter. Undoubtedly his crossing of the English Channel by air in 1909 was one of the great landmarks in the history of aviation, and it was from that day that our country really lost its insular security which protection the sea had given us through so many centuries.

Another French flier who used to be well known in England was Louis Paulhan, becoming famous by winning the prize of £10,000 given by the *Daily Mail* for the first flight from London to Manchester. Both he and Grahame-White who contested him in the race had a thrilling struggle, and both men were flying Farman machines. It was in April 1910 that this flight took place—a flight which had previously been regarded by most people as being fantastic and impossible. The winner's speed was 46 miles per hour.

Paulhan, later on in the year, did some flying at Brooklands where I met him. It is interesting to note that he had entered aviation in much the same manner as myself, for he had won the first prize at a competition for model aeroplanes which was held in Paris during the year following that organized by the *Daily Mail* in London. In Paulhan's case the first prize had been a Farman aeroplane, but without any engine. Later he was able to find someone to lend him an engine, and was thus able to get into the air.

As a result of his victory in the London-Manchester race, Paulhan was able to secure many highly paid exhibition engagements, and at that time he must have been making a large income.

Grahame-White, his fellow-competitor, was one of England's most popular pre-War pilots. We visited the Boston Flying Meeting together. He was certainly one of the few men who foresaw the possibilities of aviation, but strangely enough he did not remain in the industry. Prior to the War he ran successful flying meetings at Hendon Aerodrome, which belonged to him. Later he disposed of it at a considerable profit. On several occasions our 'Avro' machines competed at these meetings at Hendon which used to draw large crowds of spectators, although the thrills which we were able to provide less than thirty years ago would be considered very mild to-day. Well, perhaps

not, aeroplanes racing close to the ground round a a race-course is rarely seen these days, and would still be thrilling.

Geoffrey de Havilland is another of Britain's early flying pioneers. In the old days he was experimenting, and later was employed at the Royal Aircraft Establishment at Farnborough, which was then called the Royal Aircraft Factory. At this place he turned out most excellent work. He had, of course, the advantage of Government money and many facilities which most private constructors lacked. These early R.A.F. machines were of robust construction, and this, no doubt, accounted for their performance not being up to the 'Avros,' although weight does not necessarily mean strength, as can be observed in the case of the early 'push-bikes' which were very heavy; so when one fell down whilst leaning up against a kerb, it usually meant that it got bent, whereas a light modern machine merely bounces and generally settles down without damage.

In the United States at the Boston Meeting, I met Glen Curtiss, the great American pioneer; his early machines were of neat and business-like appearance and construction. They had tri-angulated under-carriages. We visited a theatre together, and I found him to be very outspoken in his views and opinions.

There have been few men in Great Britain who have done more to develop aviation in its early days than the late Lord Northcliffe. His magnificent prizes, offered through the *Daily Mail*, provided great incentives and goals for the early aeroplane constructors. On one occasion I was asked round to his London home where he introduced me to J. M. Barrie, later Sir James Barrie. They both expressed a wish to visit an exhibition of war aircraft which was being held at the Agricultural Hall. We drove there in Lord Northcliffe's Rolls-Royce, and I was able to describe

the machines to my two companions. It was clear to me that Northcliffe was a man of very wide vision, not only as regards aviation, but in other important directions, for I remember his discussing the Shannon River proposition in Ireland. He was one of the few leading men in Britain in the early days of flying who appreciated its great possibilities, and also helped to make them feasible.

Barrie was interested in what I had to tell him, but he did not ask many questions himself.

C. R. Fairey, the well-known designer, aircraft constructor and yachtsman, told me recently that he once wrote to me applying for a post in our firm. He still has my letter in reply saying that I regretted there was no vacancy for him. Fairey is very keen on yacht racing and owns a few yachts and that very delightful motor-yacht, *Evandine*, of about 500 tons.

The two editors of our leading aviation papers—*Flight* and *The Aeroplane*—are men who have done much to further the interests of the flying industry. Spooner, of *Flight*, was the first of the editors that I met. At that time he was editor of the *Auto*. Since then he has had a long service with our oldest flying paper. I have always found him very good company and I am delighted to meet him at those functions which he attends so regularly, despite his age. But he always shows a vitality which is remarkable.

C. G. Grey of *The Aeroplane* I have known for many years and always considered it remarkable the way in which he writes on so many topics of the day, even when they are not directly concerned with aviation. Although I cannot always agree with his views, yet they are generally stimulating and contain a great deal of common sense. I have never yet understood how he finds time to attend so many functions and at the same time turn out the amount of editorial matter which appears weekly in his paper.

I will conclude this chapter with short accounts of two of my neighbours. One of these, C. B. Fry, has no direct connection with flying, but he has, for many years, lived close to me at Hamble. It was some years, however, before I got to know him and when I did it was in a rather amusing manner. A brother of mine, Everard, who had been a chaplain in the Royal Navy and had later been a director of A. V. Roe & Company, Ltd., during the War, had rented a house near to where Fry lived, and they were soon on friendly terms. After the War my brother resigned his directorship and became the Vicar of Hamble.

It was at a luncheon party given by the Fairey Co. at their Hamble Works that I met Fry for the first time. Mr. Hughes, then Prime Minister of Australia, was to launch a 'Fairey' seaplane, the first of a batch ordered by the Australian Government, but as he was unable to be present, Mrs. Hughes carried out the ceremony in his place. When I saw Fry there, I went up to him and said: "I am his brother." Fry replied tersely: "It's all right, I know you."

"How do you know me," I queried, "you have never seen me before?"

"You are the wicked brother of the parson," was his still terser reply.

"You have got it all wrong," I answered. I admit that I am pretty bad, but I am not wicked enough to be a parson."

My other neighbour whom I wish to mention is Hubert Scott-Paine, of the British Power Boat Company, Ltd. He is a very cheery soul and does not mind telling a story against himself. On one occasion he met an important Air Ministry official coming out of the front entrance to Adastral House in Kingsway. Paine gave him a very hearty clap on the back, along with a cheerful salutation. But his hand-clap caused the official's 'shiner' to fall off his head on to

the pavement. This annoyed the owner of the hat and he turned on Scott-Paine, telling him that it was one of the worst exhibitions of caddishness he had ever experienced !

There has been some publicity and criticism on the profits which his company are supposed to have made. A member of Parliament in the House recently insinuated that he has had an unfair advantage over other manufacturers, and has made undue profits. As our own firm, Saunders-Roe Ltd., also builds speed-boats, it might be expected that I should be in agreement with this suggestion, but, on the contrary, I think Scott-Paine deserves all the success he has gained. He has been very enterprising in building boats at a time when it was doubtful if he could find a purchaser for them, and in doing so has risked considerable capital. This kind of enterprise deserves encouragement rather than carping and petty criticism.

CHAPTER TWELVE

MANY INVENTIONS

ANY fool can invent, so we are told. But there is also a contrary saying to the effect that it takes an able person to produce something new and useful, and a genius to make money out of it.

Many inventors of some of the most valuable ideas which in a great number of cases have been in almost universal use, have actually died in poverty. I believe that the original inventor of the Zip fastener was one of these unfortunate inventors. One of the great troubles that faces inventors is that it often costs a vast sum to uphold their patents should they be infringed or attacked in any way. The Dunlop Company, for instance, had to spend no less than £1,000,000 in upholding their patents in the early days of their existence. Thus it can be realized that the ordinary inventor, working on his own account, and usually with little capital, is at a grave disadvantage should he produce some idea which has any great commercial value. He may find that the idea is actually filched from him, and he cannot afford to defend his rights. In other cases, almost in desperation, he is forced to accept a sum for the sole rights which is quite out of proportion to its real monetary value. Even the expense of taking out the necessary patents in various countries so as to secure full protection for an invention is an extremely costly business.

As regards myself I have applied for many patents in order to avoid paying royalty fees. Whilst a large

number of my inventions have been in connection with aeroplanes, yet I have also taken out patents for ideas in a number of other directions.

I started inventing when young. In fact, I was only thirteen when I took out my first patent. This was for a reversible hand-brush for the cleaning of carpets, etc. I noticed that the end bristles of the brushes in use wore out quickly in spite of the fact that an extra amount of them were often inserted. It occurred to me that if the bristles were attached to a separate piece of wood, with a liberal supply of bristles at each end, or one-half could be soft bristles and the other half stiff ones, or again they could be all stiff or soft ones; then this separate piece of wood could be turned round on slackening a screw which allowed more even wear to take place. I arranged that the loosening of the screw could be done by the aid of a penny. The handle portion had a V-shaped groove in it which fitted the board carrying the bristles, only the V was not so acute so that a constant tension was obtained and this prevented the screw from working round and becoming loose.

I had great hopes that my patented idea would prove to be of commercial value, but it did not appeal to manufacturers. Perhaps the advantages did not weigh so heavily as its disadvantages.

Later on, when I was an apprentice at the Lancashire and Yorkshire Railway Works, I introduced some labour-saving devices on the lathes on which I was working. At that time, in order to obtain extra pay we were allowed to make time and a half if we could make a certain number of extra parts over a fixed basic rate. Actually it was possible, on occasion, to make double the number laid down, but this was not considered to be a desirable performance in the shop as it would call attention to the rate-fixer that he might have made an under-estimate in the basic

number which he had stipulated. It was, in fact, not considered to be playing the game to indicate to him his errors, if any.

At the work I was given I had a large number of parts to make in a day on a brass lathe. It happened that if I wanted to make extra money and earn time and a half there had to be an added amount of time and energy spent in starting and stopping the lathe, which was accomplished by handles which were attached to chains that were hanging over my head. I started to think how this part of the work could be made easier and I arranged this by fixing cords to the handles and then wound them round the handle-shafts of the lathe in such a way that as I turned these handles in order to make the parts, the movement automatically started and stopped the lathe as required. This idea turned out to be a valuable labour-saver, and I was able to make my time and a half with the greatest of ease.

One day, on going to my lathe, I found a lot of tin cans and other articles had been attached to these cords ; then, as I looked around wondering what might have happened, I saw many grinning faces peering at me through the forest of belts which drove the surrounding machinery. It was simply a form of practical joke.

Another machine on which I used to work was a turret-lathe, which was used for rounding the edges of cast-iron diaphragm plates that were about two feet in diameter and which were employed in the drums for vacuum brakes. The method of attaching these plates to the chuck was very crude. Actually they were bolted on by means of small set bolts which were available from a sack. These bolts frequently broke if too heavy a cut was made with the tool, and the whole arrangement was inefficient and unsatisfactory. I, therefore, planned out an improvement. I had a

special chuck made which held the diaphragm plate absolutely rigid, but with only one central bolt, in conjunction with hard steel pins, for taking the drive. This little improvement again enabled me to make time and a half comfortably on the task set me.

All my life I find that as I look on any operation which is being performed, or even on some ordinary article in common use, my mind instinctively begins to plan out how it could be simplified and made more efficient. It almost distresses me to see inefficiency in design, for it spells waste, and I have never been a believer or a worshipper of this vice. It is extraordinary how wasteful many poor people are. Some think to waste is good for trade, actually it generally prevents the purchase of something else.

On one occasion, whilst I was working on the lathe I have just described, the foreman over me noticed that I had not put in an appearance for work at the proper time in the morning. Actually I was about twenty minutes late. I had drawn my check, but had gone off to talk to another man who was very interested, like myself, in cycle racing. When I arrived at my own machine I found myself being severely reprimanded for my conduct, and the foreman told me in blunt language that I was not earning my salt. I hardly liked to point out to him that I was consistently earning time and a half, for I had the feeling that such a statement might have been against the apprenticeship code of honour.

My next invention was a change-speed gear-lever for motor cars. I brought this idea out when I was a draughtsman with Brotherhood-Crockers, Ltd., which subsequently became the Sheffield-Simplex Motor Co., Ltd. I think this gear of mine must have been the first rocking-lever employed for gear changing. Now the pivoted change-speed lever is almost universal.

The reason I designed the rocking-handle lever was to overcome the patented 'Mercedes' gate-change speed-lever. If I remember correctly there was a stiff patent fee to pay for each one that was used, so I thought that there must be other ways of doing the same work, and this resulted in my own invention.

I have already made brief mention of the fact that I entered a Russian competition which called for an improved method for coupling railway vehicles. At that time I was a marine engineer and I had plenty of spare time to carry out experiments. I schemed out many possible ways of constructing a useable coupling, but soon came to the conclusion that the coupling must fit both vertically and laterally when coupled up. This simplified making all the other connections being automatically coupled, too. The car-coupler itself was designed to act as the master coupler for all the subsidiary couplings such as vacuum brakes, heating, lighting, etc.

I found that the greatest lateral strain on the coupling came when the train was on the 'S' curve —that is when they are travelling from one line to the next. An extra amount of latitude had also to be allowed for when heavily loaded trucks had to be coupled up with lightly loaded ones.

I found the disadvantages of the standard American type of coupler to be considerable. In fact, they seemed to be quite obvious after one had studied the requirements. It appears that the American railway companies held their competition for couplers either too soon, or else they made a bad choice, or there may have been no good coupling devices. In that case the competition should have been postponed. However, having made their choice and then established it in general use, they found it a very costly business to change over to a new and better type. Thus the American railways have carried on with their old

couplings since any new couplings would have to be made interchangeable with the existing ones, and during the conversion period which might well be as much as twenty years.

One thing I found out in examining the coupler proposition was that a shunter's life is the most dangerous of all occupations. At that time more shunters were killed and injured per thousand employed at the work than the soldiers who went out to fight in the South African War, including those who died from disease as well.

One of my earliest inventions in connection with aircraft was a tail-adjusting unit. This was some years prior to the War. The invention was purchased by the Government, and the aircraft industry was then free to employ it.

I have already made mention of the patent 'Avro' strainer which I patented and which was used to such a great extent by machines during the War. Although this device brought in huge profits, yet these were quickly absorbed in other ventures or expenditure, much of which was unprofitable. It is seldom that an inventor is able to simply save the money which he has made from one of his inventions. Invariably having the inventive mind, he feels bound to go on bringing out new ideas, and some of these may run away with large sums of money about which the public hears nothing.

After the War the 'Avro' firm tried various ventures and lost much money. It was a most difficult period, when most of us found it hard to adjust our working policy to the new conditions which existed. One well-known manufacturer of aeroplanes wisely decided that he would close down his works. After a few years, when aviation began to look more promising, he started up again. Meanwhile those of us who had tried to struggle on during the lean years, had main-

tained staffs, and done a certain amount of experimental work, were much weaker than this manufacturer financially, although from the national point of view our efforts to keep going had been much more valuable. The few successful firms owe their success to the great number of unsuccessful firms, because the latter distribute wages and keep people in employment. If, on the other hand, the unfortunate employers had said we shall not be such fools as to risk our capital, we will invest our money in Government stock, where would the successful firms be? In fact the industrial system would crack up and the Government would be in a quandary. Thus we see that under the present system the nation is saved from collapse by the great number of people who struggle on hoping to pull through. But there are some 8000 bankruptcies every year, and many thousands more lose their savings in efforts to start in business.

After the War we put a small 12 h.p. 'Avro' motor car on the market. It was fitted with a saloon 'Avro' body which contained a number of new features of mine. It had a roof which could be opened, and yet when it was closed looked like a closed saloon car. The front seats were of the bucket-type and extremely comfortable. They could be adjusted quite easily, both as regards fore and aft movements, and also as regards the angle of the seat. There was no jamming which one still gets in modern cars when trying to adjust a seat. The bodies of these cars could be quickly constructed and were made of wood and aluminium, being extremely light. The cost of production had been brought down considerably compared to previous bodies which had been constructed. At that time I found the wind-screen and windows generally were much lower than they need be. I reckoned the eye should be on a level with the centre of the glass, instead of the elbows. This meant making a very high

bonnet and high sides, and many critics of the machine said it was absurd to have such a big bonnet for so small an engine.

I pointed out that to have a low bonnet and a tall glass wind-screen was still more absurd when the lower glass part of the screen was not used for seeing through, and if wood or metal was used in the lower portion instead of glass the general appearance of the whole car would be affected and look bad. Then, again, a big flat screen offers much greater head resistance than a properly designed large bonnet.

The bonnet of this car being high meant employing a rather large radiator front. This was made narrower than usual but even so it was rather large. So only the upper half was used for the radiator. A place for painting the numbers of the car was provided on the lower half, behind this number-plate was fitted a shutter blind which was concealed but which could be drawn up over the radiator in cold weather or during short journeys which doctors and shoppers often have to make.

At that time the wind-screen wiper had not been developed to any reliable extent, so the wind-screen was designed to overcome the effect of rain. This was done by dividing the wind-screen of the car into two halves, and then each half was again divided into two portions. The upper portion was made so that it would slide up and down during bad weather conditions, so that a horizontal narrow slot could be provided at the height of the eye which enabled the driver to see through, and thus not have his vision clouded by rain or mist on the glass itself. It might be imagined that this slot would let in a lot of air and even water when it was raining, but in actual practice this was not the case, for practically no rain at all came through.

I used to think that there was a market for a motor cycle which really protects the rider from the weather

and dirt, and still think so. This meant a radical change in design with a very low seat, otherwise the wind-screen becomes unwieldy. The engine of a machine of this type must be quiet and run like a dynamo. There have been a number of attempts to build a motor cycle of this type, but generally they have been cumbersome, containing all the bad faults of the motor cycle.

I built two machines; the first was chain-driven. The wheels on the second machine were held only on one side, and, as in car practice, were detachable. I did about 50,000 miles on each machine and used to enjoy riding them. It was quite easy to ride them with hands off, even over rough ground. The second machine was an excellent job and the chassis looked like a miniature car with enclosed shaft drive. The petrol consumption was very low.

About ten years ago I took out a patent for attaching glass straight into the holes of sheet metal by means of special rubber channelling. It was both a very simple and a cheap method. The glass could be round, square, oval, or any shape required. We used this method for fitting glass into our flying-boats, but I did not succeed in getting the motor trade to adopt the idea at that time, but to-day the method is universally used. Some manufacturers put front wind-screens in with this channelling, and others the rear windows. Many of the rear windows of the Ford cars are now fitted with this rubber channelling.

One of my latest patents to be extensively used is a sheet gripper. Metal fuselages such as are used on the bodies of the hulls of flying-boats and other machines are built by the riveting of sheets together. Before this can be done the metal sheets have to be held in position. At first the general custom for carrying out this operation was at the best crude and in many cases was also difficult and cumbersome. This was certainly

the case where the bolts had to be inserted in awkward places. For the method used was to place a boy inside the fuselage or body, whose job was to screw nuts on to the bolts which had been inserted by a workman on the outside. Sometimes a boy would take half an hour trying to get a nut on to the bolt simply because of the difficult position he happened to be in. It was obvious that a special device to replace this crude method was required.

With my sheet gripper all that is necessary is to pick one up and make sure the claw is sufficiently far out to take the sheets. The claw is then inserted into the hole and on pressing the gripper to the sheet and turning same the claw draws the two sheets together. This operation can be done simply using only one hand.

I have also another device patented which has the same effect. Two levers are pressed together between thumb and finger, the claw is then inserted into the hole, and then one can let go.

Another patent of mine which is of interest to householders is a tap which we have had in use for about eight years, and it should last 100 years, as the thread is much larger and on a different principle to the usual tap and much simpler. The chief advantages are that a new washer can be put on in a few seconds ; also when the head is being unscrewed to put on a new washer the water is automatically cut off. The water comes out in an even flow however small the opening. It is a cheap tap to make and it has been approved by some local authorities, but not by all. Red tape, apparently, is the reason for its non-approval.

Another idea of mine is a bonnet fastener. Last year I bought a ' S.S. Jaguar ' car and found the bonnet fasteners very awkward to fasten. I also found there were 120 parts in the four fasteners, so designed a very simple one—one only being required on each side and each fastener can be made from a plate and two

rivets. I fitted one side of the bonnet with this device and it will last as long as the car. I can instantly open the bonnet with one hand, although it is a long heavy bonnet, and also shut it with the one hand.

My latest application for a patent has just been applied for this year (1939) and deals with stabilizing floats on flying-boats. These floats are used on the wings or at the extremities of the stub floats to stabilize the machine when on the water. On a big machine such floats have to be of considerable size if they are to be effective, yet this size is a serious matter, for they increase head resistance to the whole machine and may be torn off or break the wings under adverse conditions. If they are made retractable into the wings they occupy a considerable amount of space which means very careful designing if the scheme is to be practical. It will be interesting to see which method will become the most popular

I have only made mention of a few of the inventions which I have patented. Before applying for a patent I generally make a search at the Patent Office in London, which I have known for forty-eight years, and which has been rebuilt since my first visit. Many of my inventions have been of a technical nature, which might interest engineers but hardly the general reading public. Inventing is a fascinating occupation although there are often disappointments, for a very small proportion of patents bring any revenue to their inventors. If only inventors would make a search they would save themselves and others a lot of trouble. I have had hundreds, if not thousands, of letters from inventors, and I doubt if one in a hundred of their so-called inventions can be utilised.

CHAPTER THIRTEEN

THE WORLD OF TO-DAY AND TO-MORROW

IT is a truism to say we live in a changing world. I only wish I could think we lived also in an improving world. There are so many things I would like to see accomplished which would make the lot of humanity better.

In this chapter it may, perhaps, be thought that I am roaming over a variety of topics, some of which have no direct connection with aviation, yet they are all matters on which I have definite and often strong ideas.

I have so thoroughly given my views on the reform of the currency in a later chapter that I will not repeat the arguments on this subject here. Yet this one problem and its solution is, in my opinion, at the base of most of the possible improvements in our civilization.

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A great deal requires to be done about our transportation system as a whole. There is still considerable inefficiency and waste and discomfort, all of which should be remedied. I see, for instance, locomotives puffing out streams of soot and coal-dust. This has been a source of annoyance to passengers for years, but the time has come when travellers should expect a 'fair deal.' It is to be hoped that as soon as possible there will be substituted economical 'Diesel' engines or other sources of power which will enable us to travel

in a more cleanly and comfortable way, as on some trains in America.

As regards road transportation it seems that we have scarcely touched the fringe of its vast possibilities. It appears incredible and appalling to think of our present terrific death-roll from accidents on the road. In addition there is a far greater number of persons who are incapacitated, maimed, and wounded each year. Not only is our present system of roads dangerous to the community, but they are also antiquated and inefficient. Whilst there is so much to be done in improving transportation, it seems strange to me that we should have spent over a thousand million pounds in maintaining a huge army of unemployed on the 'dole' when they would have been far better employed —both morally and materially—in carrying out useful construction works and sweeping away much of our out-of-date road system. There is so much required that demands to be done, yet we have over one million men and women, at the time of writing, eating their hearts out—doing nothing.

There is one thing I have noticed in our streets to-day which acts as a great inconvenience to rapid movement. It is the increasing size of motor vehicles. As our streets have seldom been enlarged, this means that they get more and more clogged. It would be of great assistance if many of the larger cars and motor vehicles were forbidden the use of main streets during certain hours, and such restrictions would encourage the development of covered-in motor cycle cars similar to the one I have myself constructed and which I mention in the chapter on 'Many Inventions.' These smaller vehicles would serve the purpose equally well and would reduce the road surface required per unit very considerably.

In due course we shall, no doubt, see motor vehicles fitted with bumpers all round their bodies. This

would prevent many of the accidents which now take place. Most of the present car bumpers have a most annoying way of hooking themselves on to other car bumpers when trying to get out of parking places. This annoyance could be avoided by careful designing.

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Civil aviation has made great strides, but it could make far greater ones if the world could be assured of peace along with a freedom from many of the nationalistic barriers which now spread themselves all over Europe. It is hardly realized how much the boundaries of European States have increased in length since the end of the War, with its creation of many new States. All these boundaries with their customs, currency, and passport regulations, act as a deterrent to the proper movement of trade and travellers.

The general policy of Governments in civil aviation is to try and merge air-lines into one big combine. I do not agree with this idea of monopolies in air transport, or, in fact, in any other direction. I firmly believe in healthy competition if we want to get the best results. By such methods man's natural desire to make profits helps to ensure more efficient services. There must, of course, be certain exceptions to all rules, but I am most certainly opposed to any monopoly of air transport facilities in Britain.

Another matter which affects the aviation industry amongst others is the outcry which rises from certain people about excessive profits. When I read the arguments which they propound I am, I confess, amazed at their lack of reasoning power and constructive ideas. Obviously, if profits gained in the course of fair business are to be restricted, then the losses which are usually incurred during periods of bad trade should also be allowed for. But this idea is

never recognized, although it would seem to be only just. As far as the aviation industry is concerned, it should be remembered that some firms, if not all, have had a very hard struggle to carry on during lean times. Often, after many years, there have been no profits at all—only losses. There would be little point in carrying on such businesses if there seemed to be no chance of recovering these losses. Thus, if we are to look upon profits from a reasonable angle, it should be on the basis of studying the average profits over a term of years. Even if we took spans of fifteen to twenty years it would not be unfair, for it has been for such long periods that men of faith have carried on doing valuable research and experimental work, providing employment at the unpleasant cost of increasing overdrafts. If people had not pluckily carried on, then it is quite obvious the Government would not have found organizations ready to cope with present demands for aeroplanes and other equipment when they are urgently and vitally required for Britain's defences. The idea that this past work could be rapidly improvised as occasion demanded is, of course, unsound. Even as it is many firms fall by the way before they can reach the so-called period of prosperity.

In our air defences there appear to be two schools of thought on the question whether we should concentrate mainly on bombers or fighters. There are perfectly sound arguments advanced by both sides, but I feel that they are both becoming committed to a policy which is rather involved and is not static. With the improvements which are taking place almost daily it is difficult to fix down any strict rule about the proportions of the various types of machines. I think that bombing machines will always be difficult to cope with for a number will invariably slip through most defences. I doubt if an air barrage is going to

prove really effective for it must be remembered that though anti-aircraft guns may become more and more effective, yet shots fired into the sky *must come down to earth again*. And then what happens ?

Mr. H. P. Folland advocates a single-engine, single-seater bomber that will be faster than fighters and interceptors. His proposed machine to be designed to hit a target 700 miles away and return in approximately four hours, which would be an average speed of 366 miles an hour.

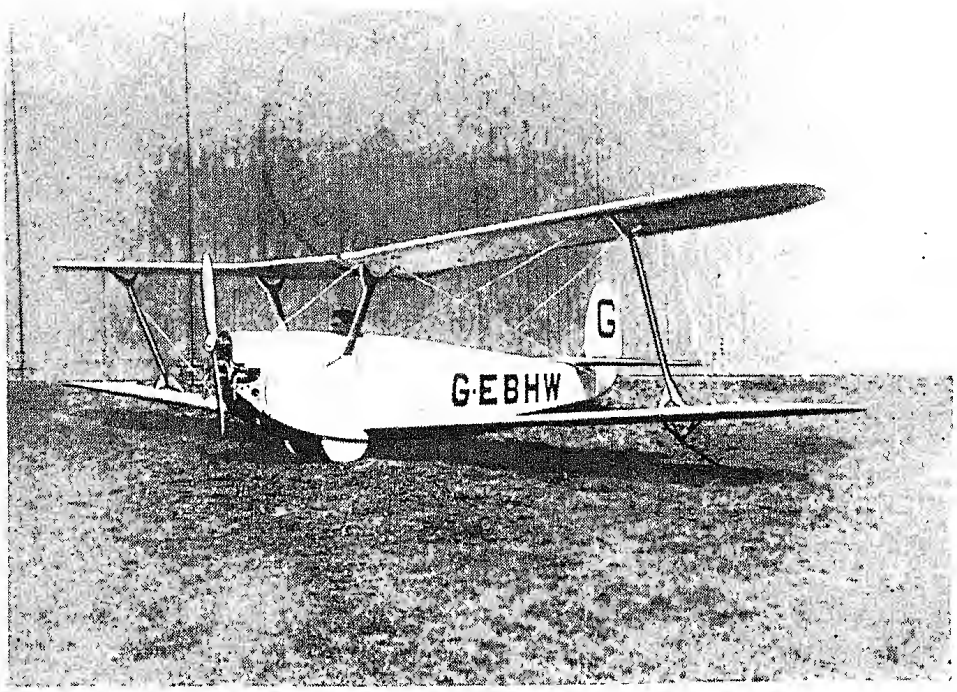
I might mention at this point certain views which I hold on the much-discussed topic of the 'Ethics of Bombing.' As long as there is such a barbarous thing in the world as war, it appears to me to be nonsense to talk about ethics at all. For, in any case, what is bombing but simply a form of long-range shelling. If you wish to stop this bombing, then just as logically you must stop long-range shelling of towns and villages, and step by step you should return to the bow and arrow state of war, really quite a good idea.

Whilst there is no one more keen than myself to see our world made humane and rational, yet I think a great deal of harm is done by the extraordinary amount of 'false thinking' which takes place. This 'false thinking' is not the same thing as mere sentimentality, but is a perversion of the mind into channels which are often warped themselves. As long as we live in this world we must realize that it is a REAL world supposed to be under the control of man's intelligence.

Thus I feel there is a great necessity of the responsible people in Britain maintaining a balanced view-point on war and world affairs as a whole. False judgments are just as dangerous as wrong thinking. Our troubles are due to mental distortion.

The object of war is to defeat the enemy. Whilst many persons, including, I think, Lord Baldwin, may

CAPT. BERT HINKLER AND THE 'AVRO AVIAN' LIGHT PLANE ON WHICH HE FLEW FROM ENGLAND TO AUSTRALIA



'AVRO' LIGHT BIPLANE, TYPE 558, WITH 2½ H.P. 'DOUGLAS' ENGINE

100 H.P. 'AVRO' SEAPLANE ARRIVING AT HELIGOLAND
The first machine of the German Naval Flight Squadron to fly from Germany to their new base at Heligoland—September 1913

'AVRO ANSON'

By courtesy of 'Flight'

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regret the invention of the aeroplane owing to some of the uses to which it has been put, yet when a nation is engaged in conflict, considerations of any kind tend to lose their force.

In the late Spanish War considerable outcry was made in this country because of the bombing of towns. Yet it is a little ironical to note that in the year 1918 King Alfonso and his Government were making representations to both Britain and Germany against the bombing of independent towns.

In the Great War, when this country was up against it in real desperation, Mr. Winston Churchill, when he was Minister of Munitions, wrote in a paper as follows :

> 'Our Air Offensive should consistently be directed at the bases and communications upon whose structure the fighting power of the enemy's armies and his fleets of the sea and of the air depends. Any injury which comes to the civil population from this process of attack must be regarded as incidental and inevitable.'

Except in cases like Abyssinia where there was no serious defence against air attack, it is usually the case that air-bombing is done from great heights —15,000 to 20,000 feet—and at this altitude it is quite absurd to think that the civilian population are distinctly aimed at. Modern methods of air-raid protection and the general inefficiency of bombing as a mode of terrorization make this mode of warfare generally most expensive to carry out, for literally the bigger proportion of bombs do not hit any worthwhile objective.

I would wish to recall certain facts which took place in the Great War, for I am quite certain that if war were to break out again, exactly the same attitude would have to be adopted.

On 17 January 1918, the declared British policy

was set out in a Memorandum which was sent to General Sir Henry Wilson, British Military Representative on the Supreme War Council, from the Chief of the Imperial General Staff at the War Office :

> 'The policy intended to be followed is to attack the important German towns systematically. . . . It is intended to concentrate on one town for successive days and then to pass on to several other towns, returning to the first town until the target is thoroughly destroyed, or at any rate until the morale of the workmen is so shaken that the output is seriously interfered with.
>
> 'Long-distance bombing will produce its maximum moral effect only if the visits are constantly repeated at short intervals, so as to produce in each area bombed a sustained anxiety. It is this recurrent bombing, as opposed to isolated and spasmodic attacks, which interrupts industrial production and undermines public confidence.'

Later on in the year an Inter-Allied Air Force was discussed between Britain and France and eventually agreement was reached on its functions which were communicated to the Italian and American Governments for their approval. These objects were described in the Agreement and also in a Memorandum sent by Marshal Foch to M. Clemenceau as being : to carry war into Germany by attacking her Industry (munition work), Commerce (economic crisis), Population (demoralization).

Marshal Foch also stated at the same time : " The Bombing Air Service . . . can, however, in quiet periods, act on the morale of the enemy people or against industrial establishments which is its secondary function."

Here you see the logical French mind which is realistic. Civilians were to be bombed for the psycho-

logical effect when the aeroplanes were not engaged otherwise.

It would seem, therefore, that if anyone in the world was to blame for air-bombing on civilian populations, our own country might well be held responsible—and simply because we were, along with the French, being purely logical on the matter. Let us, therefore, give up being hypocritical on this topic. Perhaps in the long run if war is made sufficiently horrible and nasty the world may at last come to the conclusion that more peaceful methods are the only real way of settling international disputes and jealousies. Then we may begin to think that civilization really exists.

We must, and we can, remove the chief cause of war. There is no justification for slaughtering millions of innocent people. The only justification for war material is to get rid of the people who create wars and criminally negligent governments for allowing them to do it.

What are the psychological effects of bombing? No one agrees that they are pleasant and our own memories of the bombs that were dropped in the last War are enough to make most people very scared of what may happen in the next. Then we have had the accounts and pictures of what has happened both in Spain and China.

As far as one can gather the people of cities who are bombed at first are very frightened, then later on with continuous bombing they become callous as well as frightened. There is a school of thought existing chiefly in Italy, I believe, which thinks the next war will be completely won by that nation which concentrates on war horrors from the air. It is said that it was this possibility offered by Herr Hitler which frightened our own Prime Minister into accepting the Munich Agreement.

From the lessons of Spain, however, this possibility

does not appear to me to be anything like certain. For in that country there were other causes at work which more largely contributed to the victory of the Nationalists. Franco's victory was mainly won by the justification of his cause and the gradual starvation of the population. There appears to have been no general panic even during the most destructive air-raids on Barcelona when there was also very high mortality.

It may be said that the Spaniard is more callous than the Britisher, for instance, owing to his liking for bull-fighting, but we have quite a number of 'pleasures' in England where sadistic tendencies get full play.

I do not think you can judge the British people's reactions from what has happened to other peoples of totally different temperaments.

One thing is fairly certain ; it is that the enemy will regard London as the main objective to be attacked and it is quite possible that it may become untenable. Certainly those living in the city may regard themselves as being in the front-line trenches.

At present the main method of warning the population is by syrens. So far this way has not proved conspicuously successful and, in addition, the noise that they can make may be almost as bad in its panic effect as the bombing itself. I am quite sure that the great majority of inhabitants in a bombed city will not panic, but there must obviously be a small percentage of others who will. After all we already have quite a number of foreigners who live in our midst, and some of these alone are not likely to be conspicuous by their calmness under danger. It has been suggested that the best warning should be a call to action broadcast in a calm voice. Broadcasting is the most potent form of propaganda in the modern world, and batteries of loud-speakers should be arranged

throughout all streets as is the case in many foreign cities.

Lord Trenchard recently stated that if there was a leader for every group of people in every factory, workshop, etc. there would be little panic as most people would follow a good leader like a flock of sheep. He pointed out that those who are doing the bombing never bomb anything but military objectives (or so they claim), but those who are being bombed are always non-combatants and usually women and children. He also thought that there was an exhilarating effect in retaliatory bombing of the enemy.

Whilst cold logic and reason may suggest our refusing to be drawn into retaliation and the dropping of pamphlets instead, yet I hardly think the temper of our people after being bombed would agree to this. We have seen from the last War how public opinion gets inflamed and distorted to such an extent and with such insistence that the Government has to subordinate its own views into what the public (and the Press) demands.

One thing I would wish to stress is that in time of war every able-bodied member of the population must be given some task of national importance. Where a person has a job they are much less likely to get panicky or to grumble than if they have their own responsibilities to occupy their attentions.

Whilst on the subject of our Air Raid Precautions, I happen to hold certain views on what I would term the ' Gas-mask Waste.'

It seems to me that the whole gas-mask business has been a democratic ' stunt ' (1) to make profits, and (2) to develop in favour of Jewish interests a war-complex among the British people.

The historian of the future will, undoubtedly, regard the gas-mask racket as one of the many strange

phenomena of our age. People with knowledge of modern warfare will find it difficult to believe that gas could be used by an enemy to such an extent as to make the use of gas-masks worth while. All those persons who have expert knowledge of the subject, such as R.A.F. officers and chemists, do no think there are any aeroplanes built which could carry enough gas-bombs to product sufficient effect on a population which would justify an enemy using aeroplanes in this way.

> 'They all believe,' wrote C. G. Grey [whose views are similar to mine on this matter] in *The Aeroplane*, 'that far more demoralization could be produced by high explosive and incendiary bombs. High-explosive bombing is worth while even if the population have been cleared out of the place. It wrecks buildings, jams roads, cuts off power and water supplies, and generally makes a mess. Gas-bombs are perfectly useless unless they can be used in a thickly populated area. . . . The only sound scheme is to evacuate the population.'

It is possible that some official or officials thought that the raising of a gas scare was the best way in which to make our people war-conscious, but apparently the whole business is nonsense from a practical point of view. C. G. Grey makes the comment that many of the chief A.R.P. officials are Jews !

. . . . .

One of the greatest defects of modern democracy is, in my opinion, the power wielded by certain irresponsible sections of some of the so-called 'popular' Press. Almost daily statements are made in their pages which are neither truthful nor have they even the excuse of lying in the national interest. Those responsible for the national propaganda in totalitarian countries do

try to give accurate accounts, although those who read bolshevized newspapers may think otherwise if they are the type of people who are easily misled. It seems that the one idea is to create sales based on excitement and the matter of accuracy hardly matters. The public certainly have a short memory in such matters, for if in any other branch of business or trade such ethics were generally carried out, there would be little confidence left in those who practised such tricks.

During the last few years a great deal of nonsense has been written about British aircraft construction and performance. It is obviously in the national interest that our figures of production should not be publicly supplied—it is the same with other countries—and it is not clear on what basis the very varying figures one reads of in the Press can be really based. I read on the same day that Britain's rate of production per month may be 500—750—1000 machines. It is obvious the three figures cannot all be correct. It was not so long ago that these same newspapers were providing their readers with thrills by emphasizing the smallness of our production.

It may be of interest to give the story of the development of British aviation since the end of the Great War. At the end of the War British aeroplane output had grown to tremendous figures, but one wishes to emphasize here that it is wrong to make any comparison of this output with present-day production. The modern aeroplane is a totally different machine from that of twenty years back, and it entails a tremendous increase in man-hours spent on its construction.

When the Armistice came the demand by the Government for aeroplanes was cut off as though by a guillotine. In 1919 the great majority of persons believed that we were in for a great boom in aviation and that civil flying would develop by leaps and bounds, and there was also the impression following

the orgy of spending during the War that our Air Force would also be maintained at a high level.

Actually what happened was that the idea spread that we had seen the last of war, and that there was no need for an Air Force. Then the general public did not believe as much in the utility of civil air transportation as some constructors had hoped for. Then there followed the great financial slump of 1920–21 which resulted in the whole aviation industry and everything connected with aviation having to go through a very lean time, and many firms went to the wall.

Lord Trenchard did his best to keep the nucleus of an Air Force in being, but it was not until 1923 that Sir Samuel Hoare, who was then Secretary of State for Air, started with Lord Trenchard in a scheme to rebuild the Air Force.

If the Hoare-Trenchard scheme had been allowed to develop it would have given us a big and effective Air Force. Whether there would have been no air menace from any other country, and all the present condition of perpetual crisis avoided is a matter of conjecture.

The fault with this scheme was that it was interfered with—not so much by the Labour Government who are so often blamed for the present state of European affairs, but by the so-called National Government, with its absurd one-sided disarmament schemes for bringing about peace in the world. They allowed our air defences to sink to the level of a third-class power, and in a real world that is no protection.

Fortunately the foundations on which Lord Trenchard had been building were sound. It is extremely lucky that this was the case, for whilst for a time only a small cottage was built on these foundations, yet later, when the Government realized the idiocy of their air policy they were then able to build a big castle on foundations which existed, but certainly

no credit is due to them, but rather to those who had had the foresight to see to these foundations.

To-day even Lord Trenchard must be surprised at the size of our increase, although reckoning on numbers alone we are still considerably smaller than we were at the time of the Armistice when we had 30,000 officers and 300,000 men. Still we seem now to be making up for lost time on satisfactory lines.

The story of the last few years has really been a tragedy of panic. If the Hoare-Trenchard scheme had gone through as it had originally been planned there would have been orderly expansion and hundreds of millions of pounds would have been saved.

But during those years while Russia was boasting to the world of her colossal Air Force, both Germany and Italy were quietly but busily engaged on re-building their own air arms, whilst Britain was making pitiful absurd gestures of unilateral disarmament; in view of her failure to take action in certain other directions.

We allowed our Navy to remain stationary and built no new ships; whilst our Army dwindled to the size of a frontier guard. The Air Force was likewise almost a skeleton force engaged on police work. Naturally our position in the affairs of Europe dwindled so that no other country paid the slightest attention to our wishes. We sank to the level of a fifth-rate power as far as action was concerned and the world laughed at us as far as moral weight was concerned.

It was the Italian-Abyssinian War which first drove us back to our senses. Britain then got the fright of her life when her position was seriously menaced in the Mediterranean. Lord Baldwin stated on several occasions that he never knew that Germany was re-arming as she was, which seems very strange.

Although Lord Londonderry was driven out of office—again by the screaming 'popular' Press—yet

there is no doubt that he did a great deal of valuable work in laying the foundations of our present organization. Then there followed Lord Swinton, who in his turn had to go, to be followed by the present popular Sir Kingsley Wood, who to a certain extent is reaping what his predecessors had sown.

One of Lord Swinton's innovations was the institution of shadow factories which have cost Britain a great deal of money and which might have given the same results at much less cost if a different idea of expansion had been followed. But it is a waste of time discussing alternative schemes now. We have the shadow factories and they are now in tremendous production.

Another important factor in the colossal output of aeroplanes to-day is the way in which sub-contracting has been developed. Firms of all sorts outside the aircraft industry are now being turned on to making bits and pieces of aeroplanes. Some of these firms, which range from piano-makers to morticians, may make only small parts; others build up complete units such as under-carriages or tail-fins, rudders, and elevators.

This is the sytem by which the German Air Force has been largely built up during recent years.

In our own case it is obvious that whilst all this organizing work had to be done, there could be little real increase in production, for it involved among other things the organization for the supply of raw materials in vast quantities.

The dam has now burst in 1939, and all the spade work which was done during 1937 and 1938 is now showing its results in a way which must make even the most blood-thirsty warmonger satisfied.

And we must remember that we are nowhere near the peak of our output yet. Gradually the huge engineering concerns of Britain are being organized for the building of newer and more powerful and

faster aeroplanes. Soon our output will be truly terrific and on a scale which may approach that of Germany and possibly the United States. In fact the efforts of this country to build up the World's Biggest Air Force can best be described as colossal. But whatever we do it is doubtful that we shall catch Germany up. Obviously we must try some more peaceful method.

The pity of it all is that this outpouring of wealth, of man-hours which is the world's only true wealth, should be wasted on producing weapons of destruction.

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Let me turn, for a moment, to a pleasanter subject—the question of the efficiency of women as aeroplane pilots. In my opinion it is very remarkable that some women have proved to be so good. I would especially wish to mention Miss Amy Johnson, who is really outstanding in the performances which she has put up. It is expecting a lot of women to find them dealing with machines under the most difficult circumstances which even with male pilots would be a great test of nerves and judgment.

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In this changing world my views on political questions may appear rather opposed to popular opinion, for I am not one who regards either Hitler or Mussolini as a possible world danger. On the contrary I think they are both working for the betterment of civilization, and I believe we would be far better employed if we made friends with them both. Pacts with Soviet Russia are to my mind unthinkable. I do not think that any countries Germany and Italy have taken over would wish to return to the conditions that prevailed before the union. By absorption, these countries could then be properly developed by means of German brains and resources in conjunction with their

own. Hitler, at least, would put a stop to the mass of bribery and corruption which at present exists in many of these countries and which is very obvious when one tries to do business with them. There are also other directions in which Hitler is cleaning up the countries which come under his care.

This brings me to the Jewish question. I am not forgetful of the great services which certain Jews have rendered to the world, but one should not overlook that they are the race who form the backbone of the underworld, and they have been able to obtain great power by getting control of the creation of currency. It would be much better if they had a country of their own in which to live, and Madagascar has been suggested as a highly suitable country for them.

No one is more sorry than I that innocent persons should suffer for the guilty, but Hitler, in my opinion, has been forced to do what he has done in order to save his country. I feel we owe both Mussolini and Hitler a deep debt of gratitude for suppressing Bolshevism in their own countries, for had they not done so there was every likelihood that it would have spread all over Europe, including England, as it did in Spain. If that had happened there would have been a poor look-out for civilization.

The Germans are among the best business people in the world, and they have their full share of inventive brains. There are even some countries who prefer Germans as settlers to those of almost any other race. The idea that we should go to war with them simply, as many think, on behalf of Jews and bankers, is absurd. A great fuss is made about their methods of barter in trade, but a bad currency system has forced this inefficient method upon them. Bolshevism, supported by international financiers, who I prefer to call counterfeiters, is the world's worst enemy at the present time. It will be one of the world's greatest

crimes if we are called upon to fight the Germans—for what? No one seems to know quite why we should fight them, although there is a small but noisy section of the population who appear to consider the Red and Pink countries are the paradises of the world.

A far greater danger appears to be threatening from the East where the yellow races may have to expand south. They can find no proper outlet for their peoples in Manchukuo and Siberia, and it is to the sub-tropics that they might turn their gaze. It is there they come in conflict with the white races, and it is more than likely that it will be in the Pacific that the real world war will be fought. At such a time Germany should be out ally, not our enemy.

But as mentioned elsewhere the adoption of a sound State currency system should make murderous and destructive wars out of date and enable disputes to be settled by mutual beneficial creative agreements.

About three years ago I finished off a talk on aviation made on a record at Broadcasting House as below, but the B.B.C. cut it out and, like most of the newspapers, do not apparently wish the public to be acquainted with the fact that the bankers are allowed to counterfeit nearly all the currency. I therefore make no apologies for including in the next two chapters the most important question that faces civilization at the present time; in fact I consider it to be a duty.

> "The type of aircraft that will be built in the future depends very much on the type of currency used. So long as bankers are permitted to create nearly all the currency—which they do owing to the present method of using cheques—then most aircraft will be built for destructive purposes. But if only nations will exercise their prerogative over the creation and issue of *ALL* the currency in a proper manner, then there is every likelihood that most aircraft will be made for peaceful purposes."

CHAPTER FOURTEEN

VIEWS ON CURRENCY, UNEMPLOYMENT, STRIFE, AND WAR (1)

THIS chapter of my book has nothing to do directly with my ' flying ' life, yet it embodies a very real part of my present life. History has shown on countless occasions that crusades which aim at the betterment of humanity have met with ridicule and even violent hostility from those who are quite satisfied that ' this is the best of all possible worlds.' Instinctively the mass of people appear to be satisfied with conservative ideas and regard so-called evolutionary processes as being a gradual solution of their troubles. Actually, of course, evolution if it is on wrong lines at its inception is not a right mode of progression. There comes a time when revolutionary plans which are founded on man's use of his intelligence, stirred to action by bitter experience, are the only right course to pursue. I have shown how in my pioneer life of flying I was frequently, in the early days, considered a crank with peculiar ideas, yet these ' peculiar ' ideas have proved to be logical. In the same way my advocacy of State currency to replace that of the bankers, which forms nearly all the currency, seem to me to be just as sound as were my ideas on flying. I certainly feel that they are more important to human progress and happiness.

It is not a question of high finance. All I propose to do is to return to an old practice of using tangible State currency in a new and modern way ; which will reduce taxation enormously and may abolish it.

It was about twenty years ago that I came to the conclusion, like Abraham Lincoln and others before me, that the failure of nations to exercise their prerogative over the creation and issue of the currency in a proper manner was the root cause of economic distress, which in turn creates appalling indebtedness, crushing taxation, unemployment, strife, and war.

Humanity has, from the earliest days, suffered from maladministration. Great Empires have risen and passed away, their fall being chiefly due to the failure of their currency systems. Scheming men with an unquenchable lust for power, regardless of the terrible suffering they inflict, have realized from the earliest days that if they can control the issue of currency they can have unlimited power. This power is exercised by their being the 'hidden hand' behind Governments. The power that Woodrow Wilson complained so bitterly about.

For only comparatively short periods of the world's development have the people enjoyed the benefits of a good State currency system. In most activities there is generally progress—necessity, indeed, is the mother of invention—but in the case of the currency, the improvement would mean the loss of power to a certain tiny section of the population. Consequently most currency systems in general use all over the world have, for many years, been enriching this section of the community, while depriving nations—that is the people themselves—of much vaster riches they would have produced and equitably distributed under a proper system.

There are some people who say that the present system cannot be so bad otherwise we could not have made the wonderful progress we have done in so many directions. This progress has, however, been accomplished in spite of the existing system and not because of it, and it is almost entirely due to the struggles of an

industrious people who have had to fight against terrific odds. Unfortunately, many of the real creators of wealth have died in poverty.

Under our present system there is not, and cannot be, enough money issued to buy the products of our labour without getting further and further into debt. Consequently many never have a chance to develop their natural talents and enrich themselves and the world as they could and should do under a proper system.

Owing to the wonderful inventive and productive abilities of our civilization it is now possible for even the unskilled workers employed only six hours a day and four days a week to receive an income that would permit of a high standard of living, and still enable employers to make large profits. Workers would then enjoy the benefits of a delightful home, a motor car, and the financial ability to take occasional holidays abroad—a form of genuine pleasure to many which, at present, is restricted to a very small class.

After the collapse of the Roman Empire, greatly due to the failure to create and issue the currency in a proper manner, humanity went through a very trying period, until 1150 to 1400 when all financial transactions were carried out with tangible money made from thin sheet silver, hardly any thicker than ordinary writing-paper. It did not cost its face value to produce; consequently there was considerable profit to the State and taxation was negligible. The bishops were even allowed to mint a certain amount of money with which they built the marvellous cathedrals and palaces which are amongst our most priceless heritages. By this method money got into circulation through the State and bishops paying with new coins for services. Thus the people did enjoy the benefits of seeing and using the beautiful cathedrals in return for allowing the bishops to usurp the creation and

issue of some of the currency, which should obviously be a State prerogative.

During this period of tangible State and bishops' money, civilization made great strides and the people enjoyed many holidays during the year. Six hours a day for four days a week being the normal working week.

About 1400 financial transactions became more extensive and in order to save handling large sums of tangible money, promissory notes, and IOU's were introduced. This system deprived the State, that is the people, of the incalculable benefits that can be derived from a properly created and issued currency. The change was apparently so gradual and so cunningly contrived that the people were unaware of what they had lost. Meanwhile those who were reaping a rich harvest by the changed currency conditions became more and more powerful.

In 1773 Benjamin Franklin, representing the British Colonies, visited England. He found the streets crowded with unemployed and the corners cluttered with beggars. He said : " Why is this ? What has brought about this calamity, poverty, and unemployment ? " Then he added that the Colonies had no poor-houses as they had no one to put into them.

The people of Great Britain could not understand the situation, because they had been in the habit of emptying their penitentiaries and sending the inmates along with other miserable poor persons to the Colonies, expecting them to remain poor. So they asked Franklin to tell them how he accounted for their prosperous conditions, and he said : " That is simple. In the Colonies the Government issues the money. It is called Colonial Scrip, and we issue it in the proper proportion to the demands of trade and industry."

A well-known banker, realizing that their monopoly

of lending to governments, etc., would be curtailed, if not ended, if England and other European countries were to adopt the Colonial system, persuaded our 'statesmen' and Parliament to stop the Colonies creating their own currency by introducing a Bill to that effect, and made them adopt the English banking methods. Thus they had to mortgage themselves to the Bank of England in order to obtain money.

Henceforth their money, for the first time, was based on debt, and within a year they were in the same plight as England. The bankers even had the audacity to give them only half the face value for their scrip. Franklin said: "The Colonies would gladly have borne the small tax on tea and other commodities had it not been that England took away from the Colonies their power to create their own money. This has resulted in unemployment and dissatisfaction, and was the cause of the Revolutionary War."

The tax on tea has been blamed for the loss of our American Colonies, but Benjamin Franklin said the real reason was the taking away from them the power to create their own currency. Unfortunately for America the bankers went over there and inflicted their cheque-book entry usury system on the young nation—and there they are still. President Roosevelt is hopelessly hampered and controlled by this small but powerful clique (as we are) even in the elaboration of the futile and ridiculous so-called recovery plans.

Woodrow Wilson complained bitterly about the bankers' activities. He said they were the worst-governed nation in the world; they were not allowed to have a mind of their own; and that the hidden hand of the bankers and international financiers controlled the national policy of the United States. Woodrow Wilson apparently did not realize that practically all nations were in the same boat, and that it was through the present method of using cheques

that bankers and international financiers were able to obtain their enormous power.

Andrew Jackson, President of the United States from 1829–1837, was one of the few real statesmen with whom civilization has been blessed. He saw through the bankers' usurping and pilfering methods, and, in his farewell message to the people, spoke against the banks' monopoly of the creation and issue of paper money.

Both Andrew Jackson and Abraham Lincoln predicted that if the bankers were allowed to continue creating currency the people would be shackled with bonds, debts, ever-increasing taxation, corrupt government, and eventually disaster. His prediction at last looks like materializing in the near future unless action is taken in the right direction to remedy it.

It is interesting to recall that in England about 1800, it dawned on certain observant people that banking was an easy way to make money, in more senses than one, since banks were allowed to print their own notes. So it was not surprising that these institutions increased manifold at that period. However, many people realized that it was robbery and complained for years until it was stopped by the Peel Act of 1844, but the extensive use of the present method of using cheques still enabled the bankers to lend currency of their own creation in the form of book entries with no other tangible existence. In fact it was, and is, a far more harmful method, bad as the old one was : in the latter there was a better chance to pay back borrowed tangible money, but is quite impossible to do this in all cases with money that has no tangible existence. Hence the great number of defaults and bankruptcies, which continue to increase.

In 1876 Bismarck, one of the greatest statesmen Europe has produced, revealed inside information concerning the rending asunder of the American

Republic. This information was imparted by the Iron Chancellor to Conrad Siern and published by him in *La Ville France* in March 1911. Bismarck is quoted as follows :

'The division of the United States into two federations of equal force, was decided upon long before the outbreak of the Civil War, by the High Financial Powers of Europe. These bankers were afraid that the United States, if they were to remain in one *bloc* and in one nation, would attain to economic and financial independence, which would upset their financial domination over the world.

'The voice of the Rothschilds predominated. They foresaw much booty if they could substitute two feeble democracies, indebted to the sinister financier, for the vigorous Republic, confident and self-providing. Therefore they started out their emissaries to exploit the question of slavery and thus dig an abyss between the two parts of the Republic.

'Lincoln never suspected these underground machinations.

'He was anti-slavery, and he was elected as such. But his character prevented him being the man of one party. When he had the national affairs in his hands, he perceived that these sinister financiers of Europe, the Rothschilds, wished to make him the executor of their designs. They made the rupture between the North and the South imminent. But Lincoln read their plots and soon understood that the South was not the country's worst foe, but that the sinister "financiers" were.'

[Personally I think it misleading to call them financiers. To the uninitiated it gives the impression that they have made their money by business methods, whereas it has been done by usurping a State pre-

rogative of currency creation which, in their case, is nothing less than counterfeiting on a colossal scale. The counterfeiting of coins is, of course, far more laborious. But strange though it may seem the counterfeiting of coins that are not detected is actually rendering a service to the community. For in a world which is suffering from a lack of purchasing power it increases it without any debt. Whereas the usurpers demand perennial interest until the original sum borrowed is repaid, a quite impossible task in many cases, since most of the money has no real tangible existence, as I have already explained.—A.V-R.]

'Lincoln, however, did not confide his apprehensions; he watched the gestures of the hidden hand; he did not wish to air publicly the questions which would disconcert the masses.

'He decided to eliminate the international sinister bankers by establishing a system of loans, allowing states to borrow directly from the people, without intermediary. He did not study financial questions, but his robust good sense revealed to him that the source of any wealth resides in the work and economy of the nation. He opposed issues of bonds through the international financiers.

'He obtained from Congress the right to borrow from the people by selling to them bonds of the State. The local banks were only too glad to help such a system, and the Government and the nation escaped the plots of the foreign financiers. They understood, at once, that the United States would escape their grip.

'The death of Lincoln was decided upon! Nothing was easier than to find a fanatic to strike. The death of Lincoln was a disaster for Christendom. There was no man in the United States big enough to wear his shoes.'

Actually Abraham Lincoln should not have allowed the banks to buy the bonds unless they had been bought with State money. Of course, if that had been a stipulation it would not have mattered who bought the bonds. But we should bear in mind that taxes and loans will most probably be evils of the past under a properly created and issued State currency system.

The usurpers have established a more vicious form of universal slavery over the American people and most countries than ever was established over the American negro. To use Lincoln's own words regarding the relationship between the bankers and credit dealers and the American citizen : " They have him in his prison house. They have searched his person and have left no prying instrument with him. One after another they have closed the heavy iron doors upon him and now they have him, as it were, bolted in with a lock of one hundred keys which can never be unlocked except with the concurrence of every key ; the keys in the hands of a hundred different men, and they scattered to a hundred different places ; and they stand musing as to what invention in all the dominion of mind and matter can be produced to make the impossibility of his escape more complete than it is."

At this juncture it is of particular interest to recall that the Government Bank of Venice existed for 616 years, from 1171 to 1787, and that it established a practical currency system which enriched the people *per capita* to the greatest extent the world has ever known. During this period of her existence Venice became the great seaboard, shipping, and trading centre of Europe, and instead of international debts and trading being handled in terms of gold, that metal fell 80 per cent in ducat money, while their so-called inflated fiat money stayed at 100 per cent.

The Venetian money system came to an end when

Napoleon conquered Venice; he, apparently, was a tool of the bankers in this venture. Napoleon believed that there were hoards of gold in the Venetian treasury, and that the long and consistent prosperity of the Venetian Republic was due to this fact. He at once proceeded to conquer the city and confiscate its treasury. It is true that he conquered Venice, but Napoleon did not find any golden ducats in the vaults of the Bank of Venice as he expected. He found that ages ago the original gold had been used in the arts and sciences. This is one story of the world's history that a bankers' controlled Press does not publish.

Early last June (1938) a representative of the *Manchester Evening News* rang me up on the telephone, asking me if I would write them an article for their 'Personal View' series which this paper was publishing weekly. I told him that I wrote on two subjects—'Aviation' and 'Currency Reform'—and that I would be very pleased to write on the latter subject. To my astonishment he said: "So we understand, and as we have not had an article on the currency question we will be very pleased to take one from you." I was rather amazed at his suggestion, for I knew the general attitude of the Press towards this vital subject. Even as it was I hardly expected that this newspaper would publish the article, although they offered very generously to allow me unrestrained freedom in stating my views and exposing the case I had to propound. The article was published, however, in full and it was without doubt the most outspoken article about the usurpers of the currency that has ever been published in a widely read newspaper. The following note headed my article: 'Believing, as it does, that there is need for the frank discussion of all shades of opinion, the *Manchester Evening News* has offered the unrestrained freedom of its contributors to this series—though not necessarily

agreeing with their views.' The caption to my article was—'The State Should Create All Our Currency,' says Sir Alliott Verdon-Roe.

This is the article I wrote, for it expresses the views I so strongly hold. Some of my statements have been repeated in the present chapter, but I present the text of the article more or less as it appeared originally, for, as far as I am concerned, it represents a further pioneering and also crusading attempt on my part which I feel to be of vital importance to the happiness of humanity.

'Personal views on the present unsatisfactory and alarming state of world affairs are varied. The writer thinks, without a doubt, that the major troubles of the world are due to the fact that no nation has adopted a sound currency system.

'Here some of the readers may say they do not understand high finance. The proper creation and issue of currency is not a question of high finance; it is a very simple matter that anybody of ordinary intelligence can easily understand. But for some reason best known to those concerned the public have not been enlightened on monetary affairs; consequently many people have false notions and are under the impression that it is a subject that only experts should study. Actually, there are no experts; we have to return to an old practice of using tangible State currency in a new and modern way.

. . . . .

'The silver content of our silver coinage has been halved, also the price of this metal is very low, consequently the State can make the half-crown for a few pence. By following Italy's sensible example of employing stainless steel, which we shall, no doubt, do in due course on logical grounds, then still greater profits could be made and taxation reduced

accordingly. It is absurd and quite unnecessary to attempt to make coins worth their face value, especially with metals that fluctuate in price. Within recent years silver has varied from about 1s. 6d. to 12s. 6d. an ounce ; at the latter price the old half-crown was worth about 6s. Likewise gold has increased very much in value, making a sovereign worth nearly £2.

'If the State can make huge profits on minting the metal cash, which only represents a half of 1 per cent of the currency, why not also benefit by the much greater profit to be made on the £500,000,000 odd of paper cash now issued by the Bank of England and which only represents about 4½ per cent of the currency? Yet again, the much vaster profit still on the £65,000,000,000 or so of cheques passed through the clearing banks each year in Britain, by making a cheque an order to change the ownership of tangible State notes of a special type, that will enable any sum—however large—to be easily and safely paid with one or a few of these notes.

'Under the present system the more wonderful inventions we produce and the harder we work the more we get into debt to the usurpers of the currency. If nobody had worked there would be no debts or taxation, but we would have to live like animals.

'Sad to relate many of the real creators of wealth died in poverty and often bankruptcy while usurpers or their agents have great honours bestowed upon them at times.

'The world has got into the present appalling economic mess because it has failed to adopt a tangible type of State currency to cope with the major financial transactions, a type that would be more of an embarrassment than an asset to a thief.

'According to a booklet, *Cheques*, issued by one of

the big five banks we are told: "The cheque system is the safest and most convenient form of handling money the world has ever known." This statement is misleading as the cheque system is applied at present, since cheques are about 99 per cent money in themselves, because they only handle on an average about 2s. in State money and 16s. in Bank of England notes per £100. If we wish fully to enjoy our inventive and productive abilities then cheques must handle 100 per cent State currency.

'The best system is the one that will absorb the maximum amount of currency whilst keeping prices at their desired level and enable the people to buy to the extent that they can produce.

. . . . .

'Under the present system the State receives very little when a payment is made for a large amount by cheque, say, £1,000,000. There is a twopenny stamp duty and a certain amount of benefit from the £1000 in State money such a sum handles on an average. Whereas, under the writer's proposal, although no tax is imposed, the State will benefit many thousands of times more, since such a cheque will handle £1,000,000 in State currency costing less than a penny if only one note was used.

'The only way such a note will come into existence is by rendering service to the State, so long as prices are being kept at their desired level and the people are able to buy to the extent that they can produce; or by purchasing with Government stock or cash. Issuing money on these lines saves taxing and borrowing, consequently £1,000,000 at 2½ per cent means £25,000 a year saved per £1,000,000 of new money issued, which would pay for operating the currency many times over and free the people from much taxation. In fact, there is a likelihood there

will be a surplus, owing to the wonderful inventive and productiveness of the people, so much so that there may be free hospitals, wireless, and many other benefits.

'So long as the present method of using cheques continues there is no hope of reducing debts and taxation ; on the contrary, they will go on increasing. This means there can be no peace or security, and the main cause of strife and war will not be removed. So-called governments will go on being misgovernments, because if they permit the usurpation of the currency—for the ability to create currency is the key to the greatest power of all—then the usurpers become the real government. The usurpers can make and alter laws to suit their own ends. For instance, why cannot our own Parliament deal with questions relating to the currency? Such questions have to be referred to the Bank of England, an institution owned, to a certain extent, by foreigners. It is even illegal to use more than £2 in State money to pay a debt of over that amount.

'Who legalised the hiding of reserves by the banks? No other activity can do that. Who legalised the usurpation of the currency? Which is counterfeiting on a colossal scale.

. . . . .

'Abraham Lincoln was one of the few statesmen who challenged the usurpers. When he wanted to finance the Civil War the bankers demanded 25 per cent interest ; he refused to deal with them and printed State Greenbacks with which he financed the War. He had very definite views on the currency question and contended that if the banks were permitted to create currency ("Banks created the means of payment out of nothing," see *Encyclopædia Britannica*, Vol. 15—"Money") to the extent they

were doing—and still are, owing to the present method of using cheques—that it would lead to appalling indebtedness, crushing taxation, strife, and war.

'He said the most important duty of a government was to furnish the people with a sound currency, and that they must return to a Constitutional money system. Abraham Lincoln predicted that if the system continued the banks would eventually own everything. The Ford enterprise is one of the few large industries that is not controlled by the banks in America. Recently, the Chase National Bank bought out Hearst's vast chain of newspapers. The Bank of England has just taken over control of Richard Thomas, a large and important firm.

'Shortly before Abraham Lincoln was assassinated in 1865, a leading English paper referred to his noble efforts on behalf of the American people—and humanity incidentally—as follows: "If that mischievous financial policy, which had its origin in the North American Republic during the late war in that country, should become indurated down to a fixture, then that Government will furnish its own money without cost. It will pay off its debts and be without a debt. It will have all the money necessary to carry on its commerce. It will become prosperous beyond precedent in the history of civilised governments of the world. The brains and wealth of all countries will go to North America. That Government must be destroyed or it will destroy every monarchy on the globe."

'A few years after Abraham Lincoln's death President Garfield took up the question of the State exercising its prerogative over the creation of the currency, but he too was soon assassinated. Who was responsible for these murders?

'On June 24th, 1863, just before Abraham Lincoln

commenced his "mischievous financial policy," a well-known banker wrote from England to a colleague of his in America as follows: "... highly profitable to the banking fraternity—never has there been such an opportunity to accumulate money. The few who can understand the system will either be so interested in its profits or so dependent upon its favours that there will be no opposition from that class, while, on the other hand, that great body of the people mentally incapable of comprehending the tremendous advantages that the banks derive from the system will bear its burdens without complaint, and perhaps without even suspecting that the system is inimical to their interests."

. . . . .

'Mr. Mackenzie King, the Prime Minister of Canada, is apparently the only statesman of modern times to make any promise with reference to monetary reform; this is what he said before he was elected: "Canada is faced with a great battle between the money power and the people, a battle which will be waged in the new Parliament (Alberta). I plead for a sweeping Liberal victory to carry out my policy of public control of currency and credit. Until the control and issue of currency is restored to the State, recognised as the Government's most conspicuous and sacred responsibility, all talk of the Sovereignty of Parliament and Democracy is idle and futile. To regain for the nation what has thus been lost will continue to be a first objective of Liberal effort." Many all over the world are anxiously waiting for this promise to be kept.

'Henry Ford made the following typical remark recently: "Money is just a part of our transportation system to move goods from man to man; it breaks down so often that it is time our financial

engineers developed a new model." Apparently the present model is working as designed to, viz., forcing many of those who do all the work to take all the risks, so it seems unlikely that these "engineers" will design a new model. A satisfactory new model will take us for some glorious rides and give civilisation a new outlook. It will show us that honesty is the best policy; what is physically possible is financially possible; that a large proportion of the problems politicians have had to deal with would not arise under a proper currency system; that profit-sharing after capital has had a fair return for risks run pays; that the present lower and lower yielding loan system can be replaced by a higher and higher yielding investment system; that the most gratifying joy in life is rendering service, and above all it will show that there is no need to prolong disputes by murder and destructive wars, that they can be settled by mutual beneficial creative agreements.

. . . . .

'Abraham Lincoln's murder was one of the world's greatest tragedies, for had he succeeded in carrying out his reform of the monetary system it is difficult to conceive to what an amazing extent civilisation would have developed.

'We are now at the eleventh hour; if we continue to build the huge debt and tax structure it is bound to topple over in the near future. There is no need for a committee of enquiry to waste time, the matter is too urgent. The Government's duty is clear; it should do as Abraham Lincoln partly did, and intended wholly to do, namely, exercise the State's prerogative over the creation and issue of *all* the currency. If there is any opposition from the usurpers the Government should take a very serious view of it, because usurping the currency is a far

worse crime than kidnapping—although legalised—since it has caused, and is causing, millions of times more anguish, suffering, and deaths.

'Meanwhile, it is the writer's greatest ambition to introduce a sound State currency system into some country, preferably our own, for it would be difficult to render a greater service to humanity.'

In connection with my views I might here bring in a discussion I had with H. G. Wells on the subject. As is well known, he is a writer who has very definite views on economic questions. I agree with some of these views, but not with his conclusions. It happened that I had staying with me a sister-in-law who mentioned that Mr. Wells was coming to dinner with her the following week and she thought I might like to meet him. This was arranged, and during the meal I expressed to him my views on currency reform.

Wells said to me: "You are very much in the clouds."

Myself: "But one can get a very good bird's-eye view on coming out of them."

Our talk ended by his suggesting I should send him some of my literature explaining my ideas. Amongst them I sent my article from the *Manchester Evening News* saying that I thought a book by him on the history of currency would be a good idea, and add to his reputation, and that I would be very pleased to help him with the necessary information and facts needed for writing it.

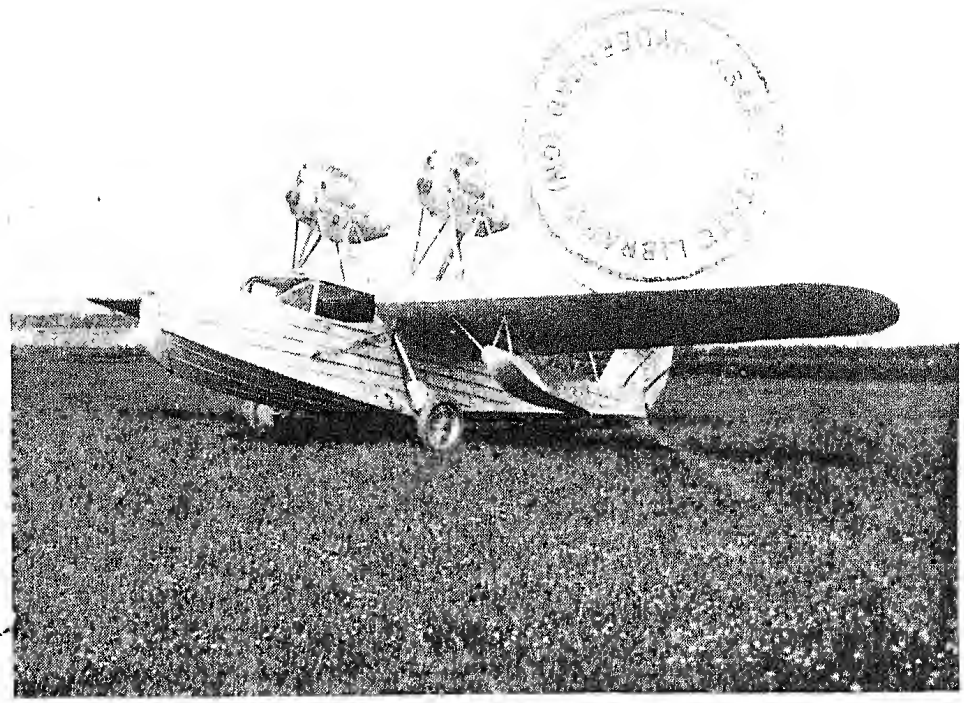
In due course I received from Mr. Wells the following stinging reply: 'It is absurd (forgive me) for you to sail into this field of thought without taking the trouble to find out what has been done ahead by others. And it is really a gross insult to come to me with this shallow gabble of yours and tell me that I shall "add to my reputation" and so on "by echoing

it." You have no grasp whatever of the monetary question.'

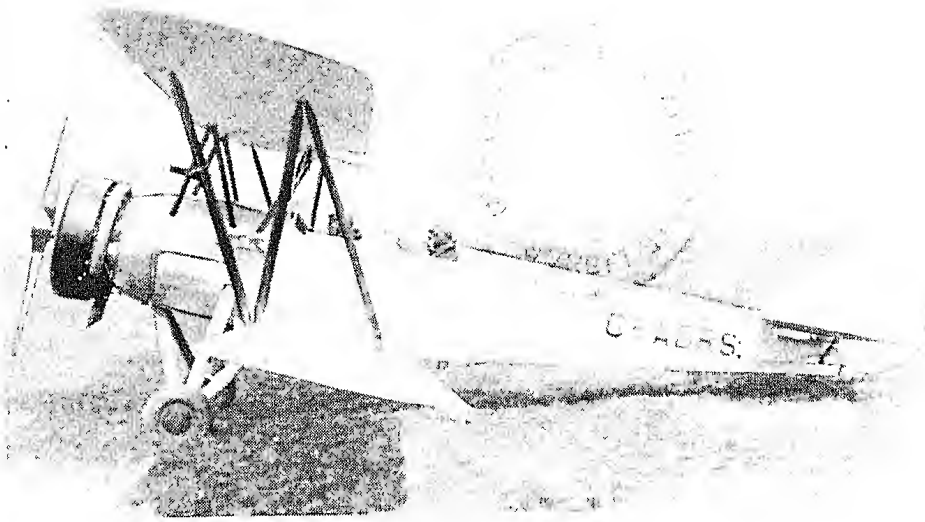
Time will prove which of us has the soundest or unsoundest views on the monetary subject. However, there was some consolation at the end of Mr. Wells' letter, for he concluded by signing himself 'yours very sincerely.'

For years I have tried to call the attention of various Prime Ministers, both in England and the Empire, to the major flaw in the financial system, namely, the present method of using cheques and the incalculable benefits to be derived by making a cheque an order to handle State currency of a special type. At the present time there is an interesting attempt by the Government of New Zealand to try and create a sound currency. Many will be interested to see what comes of the experiment. If it is successful it will have most far-reaching results elsewhere. As usual, however, the bankers are doing all they can to discredit and ruin the endeavours of Mr. Savage to create a better and more prosperous world freed from restrictive financial shackles controlled by a tiny privileged class. Otherwise there have been no satisfactory results. When I wrote to Mr. Neville Chamberlain calling his attention to the great benefits a government, nation, and the world can derive from a State currency system, he replied saying that he saw no prospects of carrying out my proposals. This statement reminds me of the attitude which was adopted previously some thirty years back when I was with a few pioneers that approached Mr. Haldane regarding the use of aircraft. I am also reminded of the answer which was described in a previous chapter dealing with my suggestions of flight in the letter to *The Times* in 1906.

Coming to more recent times I got in touch with Sir John Simon, our present Chancellor of the Exchequer, who was unable to grant me an interview,



'SARO CUTTY SARK'



'AVRO CADET'

'SARO CLOUD'

Figure on extreme right is Prince of Wales, late King Edward VIII, now Duke of Windsor.

but he asked Mr. Hawtrey, the Assistant Secretary of the Treasury and the Government's expert on such matters, to see me.

For some years I have had long discussions with Mr. Hawtrey at the Treasury, and a year or two ago came to the conclusion that these could not usefully be continued, since I had asked him whether he agreed that the banks should be allowed to create money, which they were able to do through the present cheque system. In reply, Mr. Hawtrey said that he did not see any reason why they should not do so.

So when Sir John Simon's letter arrived I telephoned Mr. Hawtrey and asked him if he thought we could usefully discuss the matter further as he knew my views and had samples of my proposed currency. He kindly replied that he would be very pleased to continue the discussions, and we had several meetings. The point we have now arrived at is the amount of tangible currency I think we would require under a sound 100 per cent State currency system. Mr. Hawtrey thinks I have an exaggerated idea of this amount.

I pointed out that the value of cheques passed through the clearing banks of the British Isles yearly, is about £65,000,000,000. Mr. Hawtrey replied to this statement: "Why take a year? Why not take ten years, and make a greater sum?" He thought a day was more convenient to handle—that would be about £185,000,000—which he considered ample to meet cheque requirements.

My reply to this was that the £185,000,000 used to-day will be a different £185,000,000 used to-morrow, and so on; each day representing a fresh lot of currency transactions. True, at times, the same units will reappear, the lesser ones more frequently, as a rule, than the greater ones. That is

'SARO CLOUD'
Figure on extreme right is Prince of Wales, late King Edward VIII, now Duke of Windsor.

to say, if it would require £65,000,000,000 in cheques, the usual amount, to meet all annual requirements, and if on an average, taking large units with small, there were six exchanges per annum, then about £11,000,000,000 worth of notes would be required to deal with the present amount of business.

But under a good State currency system, trade would increase enormously, since purchasing power would be made to keep pace with full productive capacity. So it would be difficult to gauge the actual amounts of notes required which certainly would be very great. Though I do not agree with Mr. Hawtrey's suggestion that about £185,000,000 in my proposed State notes would be able to cope with cheques when they cease to be temporary money in themselves and become an order to change the ownership of these special notes. In practice the actual amount of these notes will not be fixed, as it will be found necessary to constantly add to the existing notes in order to keep prices at their desired level.

Therefore it will be seen why the best system is the one that will absorb the maximum amount of currency. And how it is possible to inject currency (or to use an expression which the bankers are fond of frightening the people with, namely, inflation) that is to 'inflate' to the right pressure whilst keeping prices at their desired level and enable the people to buy to the extent that they can produce. The more currency a government can issue, the less will be taxation. It is even possible that there will be no taxation. There may be a surplus. If so, there could be free hospitals, wireless, etc. The large staff who now handle wireless licences will be paid to do creative work, the demand for which would be enormous.

CHAPTER FIFTEEN

VIEWS ON CURRENCY, UNEMPLOYMENT, STRIFE, AND WAR (2)

I AM often asked what I would do if put in charge of creating and issuing the currency. Briefly, the first thing I would do would be to give the people a taxation holiday. This would soon go a long way towards curing unemployment. It would never be necessary to return to direct taxation again, and the large number of people engaged in taxation matters would then be free to do creative work in the ever-expanding industries and enterprises. Many industries, as I have pointed out elsewhere, have lost money, as there is not enough issued to buy the production without getting further into debt.

In fact, it may be possible to eliminate taxation altogether and abolish this evil which handicaps business. But if a tax was found necessary, a very small one on the huge profits, taken at the source and therefore scarcely felt, should suffice.

I would nationalize the banks, buying the shareholders out at the market price. Whilst certain benefits would accrue to the people by doing this, the major one would be lost if not followed up by a sound system of creating and issuing currency. The hidden reserves—whatever they may be—would then belong to the State, and that part of the National Debt—much of it—that is owned by the banks would be cancelled, that is go back to the people, the rightful owners, from whom it should never have been taken.

The creative industries must owe the banks well over £1,000,000,000. I would inform all these industries that their bank overdraft had been cancelled. This would increase the value of these industrial shares, not only because the overdrafts had been wiped out, but also because of the increased business which would result from the extra purchasing power acquired by tax elimination.

We must remember that many industries have struggled on for years, just able to pay the interest on their bank loans, whilst shareholders have had nothing. In other words these industries have been forced to do all the work and take all the risks.

Successful concerns owe their success to the struggles of a great number of unsuccessful firms, who are the victims of a bad currency system. It may be possible to reward these industries and other useful activities still further, according to the extra currency that may be available after meeting all taxation requirements, along with the cost of a free medical service, free wireless and other benefits. In the case of wireless, the large staff necessary to collect the millions of licence fees—which under the present system reduces the purchasing power of the people—will be free to engage in creative work even as millions now employed unproductively will be. If governments can give away over £1,000,000,000 to the people for doing nothing, which they have done since the War, the proposal to cancel bank overdrafts should not be considered extraordinary.

I would make profit-sharing compulsory after capital had a fair return for risks run. Actually nothing would be given away when this scheme becomes universal. The only way we can buy to the extent that we can produce is by everybody being better paid for services rendered, or receiving a higher yield on their investments—or both. For employees may be

able to receive more than their wages in profits, although wages also would be higher than at present. Under such a system shareholders' interests would be considered by all concerned and strikes should be unknown.

When currency is created and issued properly by the State, good government would be almost automatic. In fact, most of the problems and questions with which we now wrestle so ineffectively and have done for the last few hundreds of years, would never arise. The first nation to do its duty as regards the currency will become exceptionally strong financially, industrially, and in every other conceivable way. There is, in fact, no more difficulty in issuing the correct amount of currency than there is in issuing the right amount of food to the community.

A government can pay for all services rendered to it with new currency so long as prices are kept at the desired level. Should prices rise beyond this standard (taken, say, over 200 commodities) then the Government would pay for services rendered with the existing currency until the fall again enables it to resume issuing new currency. Actually production and invention would increase enormously under a system of properly created and issued currency.

As regards the actual 'silver' currency, stainless steel may be used instead of the present unsatisfactory mixture—at present it is 50 : 50 of silver and copper. If so, still greater profits would accrue to the State on minting, although the present half-crown is being made for only a few pence. Certain steps would be taken to guard against counterfeiting which would be less likely in any case, since it will be quite easy to make a comfortable living by honest means. At the present time the great bulk of our criminals are the product of poverty and unemployment.

It would, of course, be necessary to increase the

metal cash from about £80,000,000 to well over £100,000,000 on account of increased business. The metal cash, although a very useful and profitable part of our currency, is not very important as regards revenue compared to the paper cash and cheque money.

The Bank of England paper cash would be replaced by State notes bearing an illustration of His Majesty the King. Again the paper cash only represents a small fraction of the currency, although about £500,000,000 is in existence at the present time. It may be necessary to increase this to £1,000,000,000 within a year or two.

Cheques are by far the most important part of our money system, and form about 95 per cent of the currency. About £65,000,000,000 in cheque money is passed through the clearing banks of the British Isles yearly. Here exists an enormous source of revenue which could be obtained without inflicting taxation. It has been neglected by governments since the introduction of the cheque system.

I should like to make a suggestion at this point to the effect that a good government ought to say to the people: "If you will invent and create, we will provide you with the currency in order that you may buy to the fullest extent of your production." But no government has ever made so sensible a statement on monetary policy for hundreds of years. In fact, whenever the question of currency arises, instead of debating it, it is usual to refer it to the Bank of England, an institution owned to a certain extent by foreigners. This sinister flaw should have been rectified long ago, for it is the root cause of economic distress, unemployment, strife, and war.

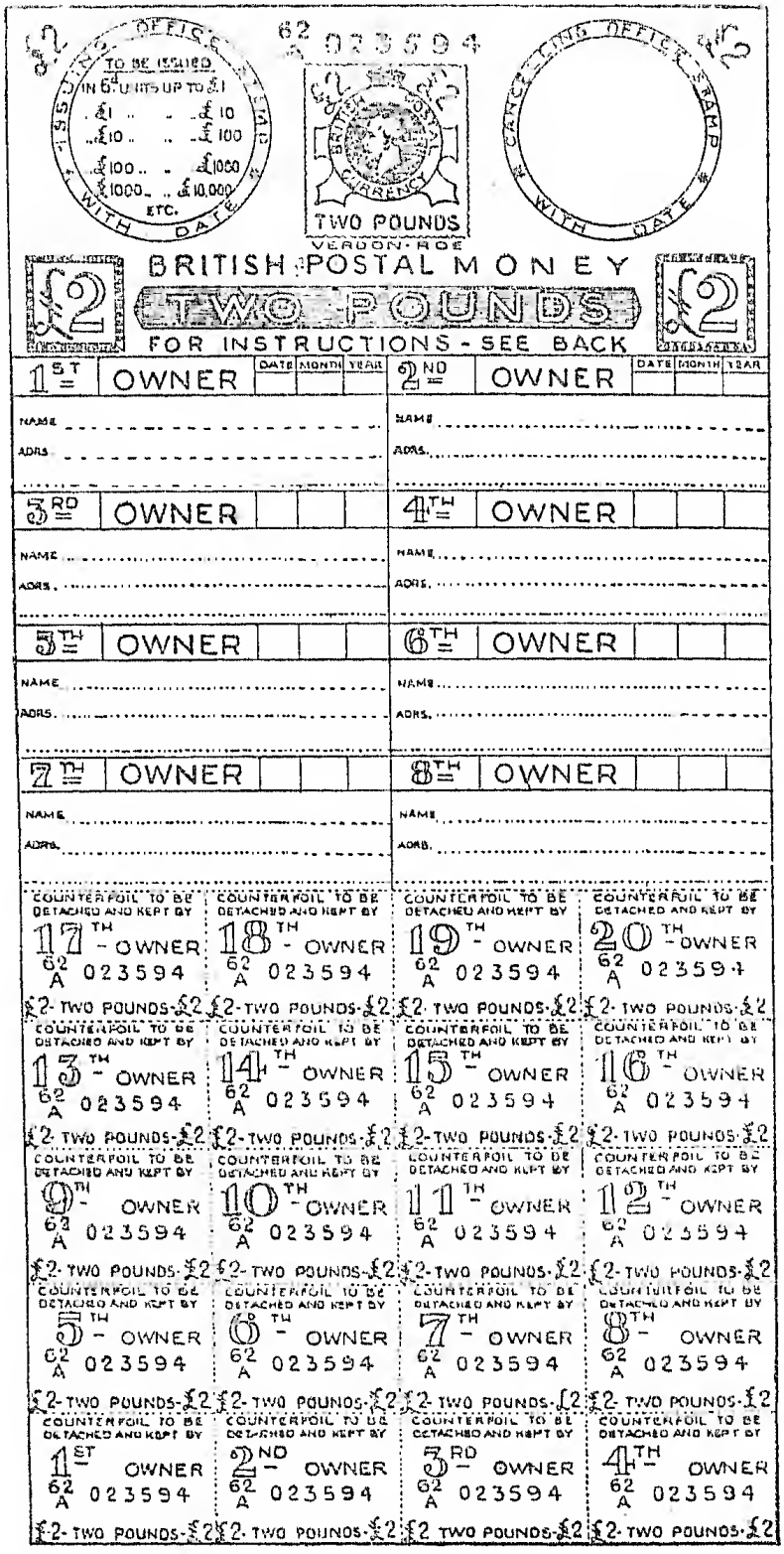
It is true that there is a twopenny tax on each cheque which a person uses, but the total sum received on this account is paltry and insignificant compared to what

would accrue to the State if it made a cheque an order to transfer the ownership of a special type of State note, which could be called 'State Postal Currency,' or a 'State Postal Money Note.'

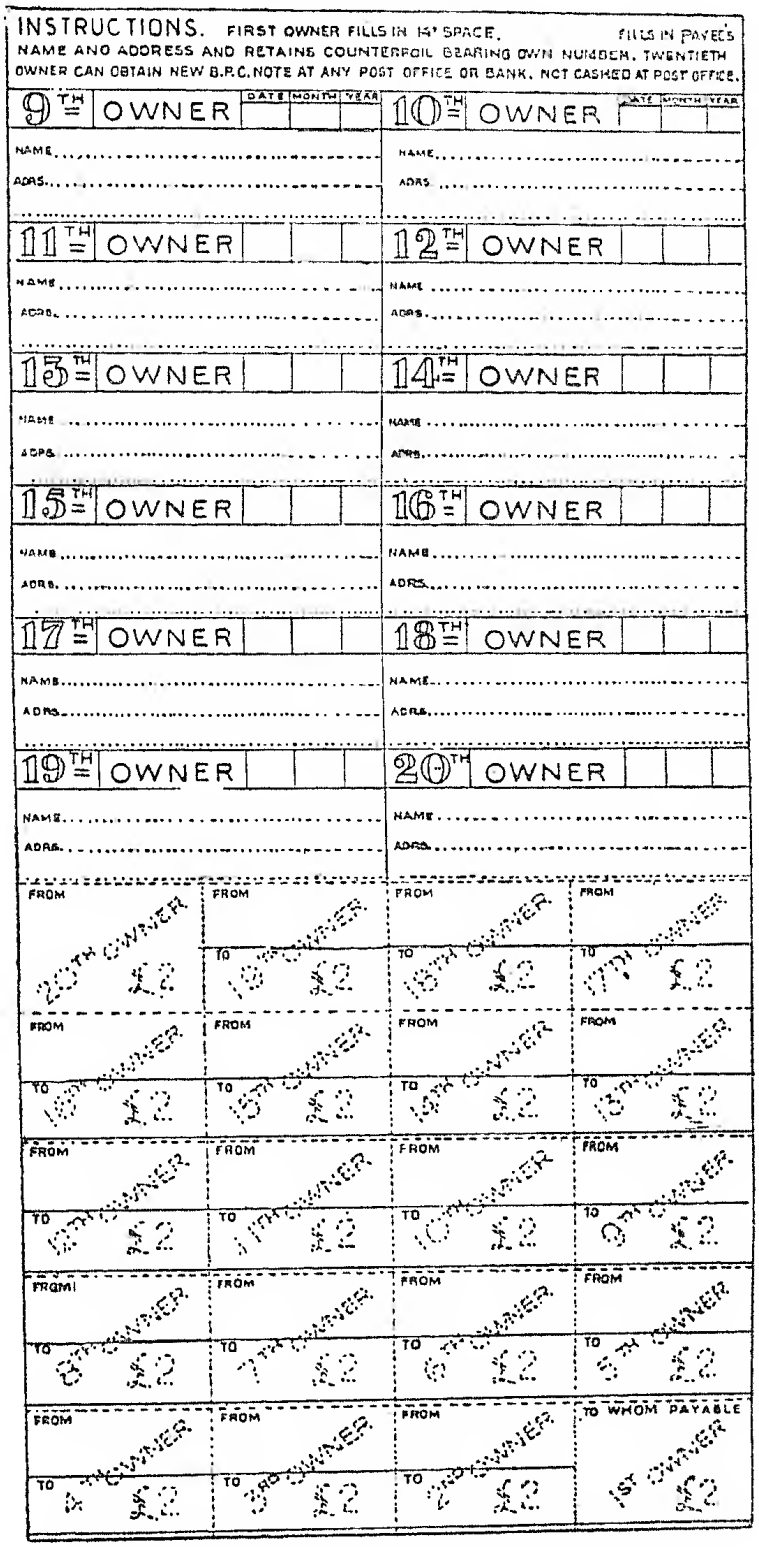
This may seem to be a rather complicated scheme which I have suggested, but actually it would simplify the work at banks, as the present cheque system is very expensive to operate, costing about 1/– for each cheque which is cleared. That is why some banks request their clients not to use cheques for payments under £1. A cheque under the present system has to pass through a dozen hands. I will not go into details of the actual working for my various schemes, but will simply state that it would cost very little to deal with a cheque even for a very large amount. For instance, a cheque for £1,960,000 would be paid in three of the special Notes, namely, £1,000,000, £900,000, and £60,000; these could be selected, filled in, and dispatched in a few seconds.

Something like £3,000,000,000 worth of these Notes would be required to deal with cheques of £10 and under, as about 75 per cent of cheques issued are for such sums. But if people prefer they could use the proposed State Postal Money Note direct, which they would doubtless do for small amounts of £10 and under. This would save the banks much unprofitable work, unless a charge was made which would most probably be done under the new system; if so, then many people would use the free-of-stamp duty Notes direct for small amounts.

If it is profitable for the State to sell large quantities of stamps to collectors, it is far more profitable to get currency into circulation; since the purchase of stamps by nationals for this purpose reduces their purchasing power accordingly. Currency under a proper system only comes into circulation as a result of rendering service to the State (or in exchange for



State Postal Note (example). FRONT. About half size.



State Postal Note (example). BACK.

Government stock until there are no outstanding stocks. A government should make money on behalf of the people and not borrow it). Currency will only be put into circulation so long as prices are being kept at their desired level. Therefore it is more profitable to the State to get a £1,000,000 worth of new currency into circulation than to sell £1,000,000 worth of stamps.

The best currency system is the one that will absorb the maximum amount of currency whilst keeping prices at their desired level and enable the people to buy to the fullest possible extent what they can produce. It seems obvious that we must be under some wrong system when we see a world glutted with essential goods which many people would like to buy—yet they cannot apparently afford to do so. Consequently vast quantities of goods are destroyed or restricted. We are trying to make an absurd and fraudulent financial system fit a possible wonderful productive system, instead of making a State currency system fit a really wonderful productive system.

German Inflation

People often think that printing money would be 'inflation' and they make mention of what happened in Germany some years ago. That country printed unlimited quantities of marks in order to rid herself of foreign debts. I heard of a Liverpool man who had invested £100,000 in Germany, and only received 7½d. in settlement of his investment. A packet of cigarettes at that time cost a fortune judged by previous standards.

Both Henry Ford and Edison have pointed out that too much money as well as too little money is bad. Just enough money to move trade is all, they consider, should be necessary. Personally I prefer to say: Enough money to buy to the fullest extent possible of

production whilst keeping prices at their desired level. To do as Germany did was bound to bring about the state of affairs that did occur.

Germany's Financial Policy

Herr Hitler has been saying some very harsh things about orthodox financial policy and bankers, recently. Germany has broken away from orthodoxy and has adopted a 'goods' standard. Hitler has freed his country from the grip of the usurpers and has said that for every mark that is printed there is a mark's worth of goods at the back of it. Time alone will prove if Germany has adopted a good system, meanwhile there are no unemployed and labour-saving devices are being constantly introduced. Such being the case it seems to me that we cannot afford to have a single person idle if we are to avoid being superseded by a more vigorous and practical nation.

The British Press has been very silent on Germany's financial policy, and they rarely report those sections of Hitler's speeches which refer to this subject.

In Germany to-day some thousands of miles of fine modern one-way traffic roads have been built, and many other great constructional works carried out. I believe this has been mostly done without increasing their debt. One must assume that the State did its duty and created the money for this purpose instead of allowing the bankers to do so, and thus battening more debt on to the people. I do not think Germany has yet adopted the best system as taxes are still heavy, and there are restrictions against the export of currency from the country. Direct taxation, as I have pointed out, is unnecessary and the more money we can afford to keep by ready for spending or investing, the less will be the taxation or the more we shall have the benefits of free hospitals, free wireless, etc.

Likewise money sent abroad is equally beneficial

because the Government can issue more money in order to keep prices at their desired level. It is more advantageous from the national point of view to get, say, £1,000 into circulation than for a government to sell £1,000 worth of stamps, a point mentioned previously.

The Gold Standard

Herr Hitler has been telling his own people some home truths about the insane gold standard and the bankers' controlled currency system in general use in most countries. When the history of events during the past few hundred years is written, the farcical and pilfering monetary methods that have been employed, will make future generations wonder how human beings could have been so blind and stupid. Most of the big bankers predicted dreadful things would happen if this country went off the gold standard. If they were so hopelessly wrong in their surmises why should so many place such implicit faith in their other utterances.

Gold was believed to act as a regulator for the currency by ensuring that it shall be expanded only when the Bank of England acquired the gold. This is clearly just a fetish. How can the fortuitous arrival and disappearance of gold have any bearing on the amount of currency required by the people. Currency must be issued in some ratio to production and productive capacity. A 'goods' standard is the only practical method. New currency can always be added to the existing amount so long as prices are kept at their desired level.

I refuse to believe that the chairmen of the 'Big Five' banks are any wiser in their utterances during their annual shareholders' meetings than anyone else who has studied the matter, even though he may not be a banker. It is a strange phenomenon of our times

that a feeling should be created as though these chairmen should be endowed with some kind of financial infallibility in their utterances. It is a form of almost superstitious belief which savours of the Dark Ages rather than an era which we like to think is intelligent and civilized. However, time will show how sensible or otherwise they have been before and since we left the gold standard.

The destruction of food and restriction of production is another of the insane activities, or rather de-activities, that has been inflicted on the helpless masses while they have been starving, which will also amaze future generations. Yes, the fruits of labour have been destroyed in an effort to make production fit the quantity of money instead of making the amount of money fit production. These are the indescribable and foolish things which occur under a 'sound' financial system that we are told is the 'envy of the world.'

CHAPTER SIXTEEN

DOWN THE YEARS—TO WHAT?

I AM frequently being asked to express my views and ideas regarding the possible future developments of flying. Sometimes non-technical persons with vivid and highly coloured imaginations picture the most fantastic developments in the flying-machine. Considering the miraculous inventions which have taken place during the last few years in our own lifetime, it would not be correct to rule out even the most absurd of these phantasies, even though they may emanate purely from the imagination of writers with a flair for highly coloured ideas. But those persons with technical knowledge are more likely to visualize correctly future developments. This generation, I feel sure, will live to see wonderful achievements in the world of aviation if we can remain sane and preserve the civilization which has slowly grown up through the centuries from the time we emerged from the dark Middle Ages.

Perhaps this is a big qualification when we look around the world to-day and see its present state. Yet history has, time and again, shown how the world's super-civilizations have crashed. The life of man has then reverted to barbarism or, at best, a reversion to the simple life. Perhaps this is simply some law of nature, but I prefer to think that it is due to mankind's abuse and refusal to accept the greatest gift with which we are endowed—the use of our intelligence. The

Almighty gave us brains to think with, if we do not use them properly then we suffer accordingly.

When these crashes have occurred a revival to civilization has taken time before it has been recreated. Often there has been an interval of centuries. Then man's native intelligence has painfully and slowly brought back into existence this civilization only to find, perhaps after many years, that it lacks the essential keystone, namely, a proper appreciation of the causes which have brought about the decline and fall of past civilizations. In the last chapter I have described the economic chaos that, in my opinion, is now approaching a climax. Clearly if our civilization crashes, and many things point this way, then flying and all its great possibilities will also disappear. If such were to be the case all the ideas which I have in mind could never come to fruition. But if we take the brighter view and allow that sanity may prevail and that the world will gradually see daylight, then I would like to show what developments are likely, in my view, to take place within our own lifetimes. I do not feel prepared to go any further into the realm of the imagination, for I would be separated from available known facts. It is on these I wish to build.

There is, however, yet another qualification I would wish to make in bringing forward my ideas in an intelligent forecast, even if one only thinks of the developments during the next twenty years. At the risk of being called a 'crank' I wish to re-emphasize the fact that as long as people are suffering, as they do now, under a crippling indebtedness and a crushing taxation—all pointing to a state of war—then most aircraft will be built for destructive purposes. This definitely results in many interesting and possibly important experiments being delayed owing to the insatiable demand and pressure in obtaining delivery of aircraft designed purely for military and naval use

and purposes. Under these conditions aircraft will become more and more deadly and simply diabolical instruments of war and destruction. What a fantastic and absolutely mad position we are now in. What an appalling outlook which we have to envisage yet, unless there is a change of heart amongst the nations and some reversion to common sense and the ordinary rules of civilized conduct, it would appear that this is another abyss which presents the doom for which we are rapidly heading. It is the old story of the devil finding evil work for idle hands (and minds) to do.

The rapid strides which have taken place in aeroplanes during the last few years indicate clearly that progress can be made in design and ideas, and I wish to emphasize that we have not by any means arrived at finality in aircraft types. Quite apart from the instances which I am describing in this chapter, there are many other directions in which inventors are seeking to improve flying-machines.

There are rays of hope. I see in certain directions the piercing of the dark clouds around us. Bold experiments are being made in certain countries in the hope of finding a satisfactory State currency system. If a good system is adopted then there should emerge incalculable benefits which will be appreciated by the world at large. It is the nightmare of debt —national indebtedness—which hangs over most countries like some deadly pall. Actually there is no need to worry, it can never be repaid. Escape from this will then bring escape from the tragic horrors of war which is gradually being forced on all countries as apparently offering the only way out of their troubles. But if common sense in economic matters does come to pass, then I believe disputes in the future will be settled by mutual beneficial creative agreements, and they will not be prolonged by insane destructive wars which obviously solve no problems

on any basis except power and might which frequently is anything but justice.

When people are so busy creating real wealth and improving their standards of living to an extent that is, at the present time, believed to be impossible, then they will also be far too busy to make much war material. But then, it should not be necessary to do this for the reasons which I have already stated. If this is the case then most aircraft will be built for purely business and pleasure purposes. Even then the higher standard of living which will be enjoyed will be a small matter compared to the peace and security that will then prevail. Imagine, for a moment, how pleasant this world might be if we were freed from the present chronic state of fear and crises.

If this state of affairs does come to pass, and I base my forecasts on this supposition, then I believe we will see machines built which will enable us to fly from our back-gardens and alight in them again safely. There is no reason why we should not have flying-machines which can be as easily operated as the present small motor car, and they will perform feats which are impossible to the latter. I believe, for instance, that with such flying-machines we will be able to pluck fruit from trees, rescue people from ships in distress, or from burning buildings. They would, of course, be machines specially designed for this purpose, but they are feasible and would be the means of saving many lives. When aircraft can be made to handle in this manner, and provided they can be easily flown and landed quite gently and safely should the engine or motive power fail, then we may see them employed to an extent which might seem almost incredible at the present time. They would undoubtedly be able to undertake many of the tasks for which motor cars are adapted at the present time.

Readers may think it strange that a person such as

myself who is believed to be doing well out of the present armaments 'boom' should wish to enunciate such peaceful plans of development. But I am certain that engineers and designers would far rather use their brains and their energies in the path of peaceful service to the community. We have not the slightest wish to be Frankensteins seeking whom we may destroy. It is indeed a strange paradox that creative brains should be so busily engaged in the design of apparatus whose sole aim is destruction and death—the reverse of creation. Can any civilized person visualize such a prospect with equanimity? I prefer to agree with Henry Ford, who is a good judge, when he offered to bet, recently, even money that there will be no more major wars.

In this instance I prefer to be an optimist rather than a pessimist.

Some years ago I said to the late Sir Henry Royce when he was Mr. Royce: "When you engine designers have made the petrol-engine as perfect as human ingenuity can make it, then some method of propulsion will surely be developed that will make existing engines and propellers unnecessary in aeroplanes." I believed then, and I believe now, that the aeroplane engine as we know it will be superseded by something radically different. This is not merely a case of my own feelings and imagination, but it is based on certain experiments which I saw fairly recently in Paris.

Before describing these experiments I would like to bring before the reader who is not versed in the matter the broad principles on which the flight of an aeroplane depends. Many persons, I find, do not realize that when a propeller revolves rapidly, it draws the machine through the air more by suction than by traction. The air rushes over the curved back of the propeller-blade, creating a vacuum. Likewise the air rushes

over the top curvature of the wings, again creating a vacuum. Thus an aeroplane is held up more by suction than by floating on air.

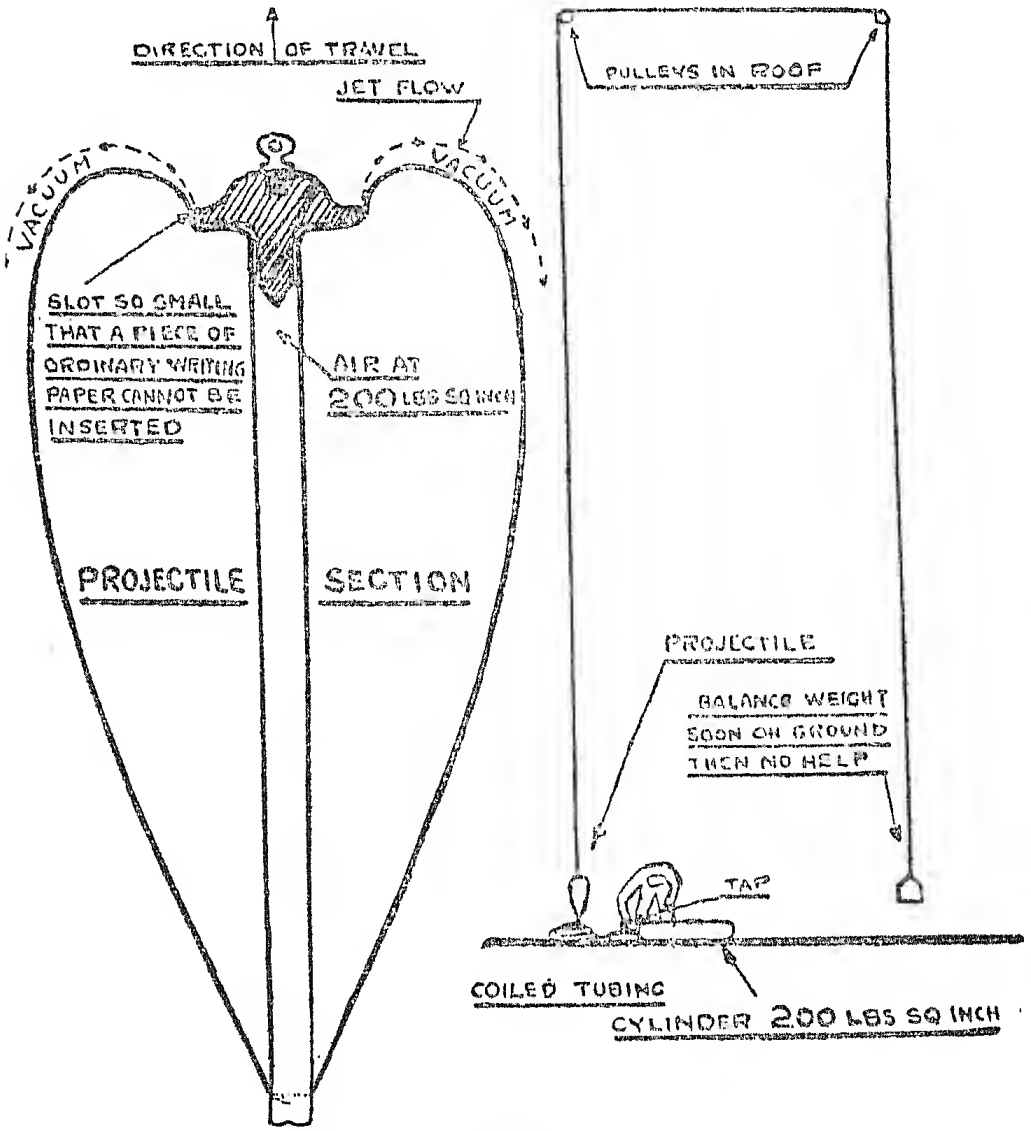
Now there is a limit to the speeds possible in flight by the present-day propellers. In fact that speed has been already nearly attained. Cavitation sets in when speeds above that of sound are reached by the propeller tips, and then the propeller loses its effectiveness.

It will be apparent, then, that designers realizing the limitations of propellers must consider some other means for the creation of the vital vacuum necessary for the creation of flight. It is the experiments which I saw in Paris that were devoted to this object and which I now propose to describe.

In the first experiment there was a simple apparatus which is more easily understood by a study of the diagram overleaf. It will be noted that a streamlined object, shaped like a bomb, which I will term the 'projectile,' is suspended from the roof of the building in which the experiment was conducted by a cord that passed over two pulleys which were attached to the roof girders. This projectile was about 15 inches in length and 5 inches in diameter. It weighed about 10 lb. At the other end of the cord was a balancing weight. It was so arranged that both the projectile and the balancing weight were about three feet off the ground when the experiment started.

At the lower trailing end of the projectile was attached a coiled rubber tubing, about one inch in diameter, and this communicated with a steel cylinder containing compressed air pumped up to a pressure of 200 lb. per square inch. Through the length of the projectile there ran a passage which led to a circular slot in the nose; this was about two inches in diameter and it was so fine that it would not permit of the insertion of a sheet of paper of ordinary writing-pad

thickness. When the air was released it passed first through the passage within the projectile and then escaped, at a considerable velocity, through the slot. If it had not been for the projecting surface of the



projectile's nose this jet of air would have escaped in cylindrical form, but, as it was, the air spread out in tulip-fashion and was deflected so that it followed the nose curvature, flowing aft, and creating a vacuum at the front end. This caused the projectile to shoot up to the roof; the only sound I heard was a quiet

hissing noise. As soon as the projectile rose three feet off the ground, the weight at the other end of the cord descended to the ground and gave no further assistance. When the projectile reached the roof the valve on the compressed-air cylinder was closed which resulted in it (the projectile) falling back to the ground.

I will now explain what had taken place. A vacuum had been created at the nose of the projectile and then atmospheric pressure on the rear portion forced it up into the vacuum which consequently caused the movement upwards.

This action can, perhaps, be more clearly demonstrated if I show what had happened in another way. It was the same principle which works when a bottle full of water is turned upside down into a saucer containing water. The water will not come out of the bottle until some of the water has been removed from the saucer. This is due to the presence of a vacuum. In the same way if air is extracted from a container and its base is then placed in water, this water will be forced upwards by the pressure of the atmosphere.

I saw another experiment which was of a similar nature and embodied the same principles. In this instance there were two of these projectiles which were mounted on the end of a piece of tubing and this revolved on a central bearing. It was arranged that compressed air could be fed to the two projectiles as they revolved round this central bearing. Air at 200 lb. pressure per square inch drove the two projectiles round an eight-foot diameter circle at a speed which was estimated to be between 600 to 700 miles an hour.

There was one other experiment made, although in this instance I did not actually witness it myself. It was made on the River Seine. A motor-boat hull was fitted with a short mast of steel tubing to which was attached a circular rim of stream-line section—about

two feet in diameter. It was rather like the exhaust manifold of a radial engine, looking like a wheel with direct spokes; these were tubes supplying steam which was produced by a boiler of the Bellville type. The steam was supplied to the outer rim at a pressure of about 1800 lb. per square inch. The steam escaped through a fine slot in the nose of this stream-line ring, and flowed backwards as in the case of the projectile. The mast was well-braced to take the thrust which was greater than had been expected during the first experiments, for the bracing-wires broke on opening the valve which liberated the steam. Speeds of 60 miles an hour were obtained by this boat with four people on it. Crude oil was consumed at the rate of 30 lb. an hour against 90 lb. of petrol if an ordinary engine and water propeller had been used.

Although these experiments did not deal directly with aeroplanes, yet I see no reason why these same processes should not be applied to them. The principles employed remain the same. It would, of course, be necessary for air under high pressure to be generated on board aircraft. With a petrol-engine this would be difficult, if not impossible, for this type of engine is most wasteful since its exhaust gases escape at a very high temperature—about 1100 degrees centigrade. But in the last experiment which I have described, the inventor claimed that he had used the heat down to about 100 degrees centigrade. He also claimed to have propelled his boat three times as far on the same amount of fuel, compared to an ordinary petrol-engine.

At the time I was asked to take a financial interest in the experiments which were being conducted. I was definitely very interested in them, but on inquiring later into the matter I was told the French Government was interesting itself in the matter, and apparently further financial assistance was not required.

It was also clear from these experiments that the

propeller could be dispensed with. It is not an essential for propulsion. The propeller is, in fact, the cause of much more noise than the engine on most aircraft. With the methods referred to in the experiments I have described there opens the way for a simple and direct method of abolishing the revolving propeller. It is not surprising that when a propeller is driven through the air at high speeds, cutting its way and creating the required vacuum, it should cause more noise than the engine ; so it will be a great boon if propellers can be abolished as well as the present noisy engine, apart from other advantages.

When a vacuum is created on the front upper surface of the wings in the manner described in these experiments, the weight of the atmosphere presses on the tapered trailing portion of the wing, forcing it upwards into the vacuum ; thus forward motion is obtained horizontally or even vertically upwards, provided the machine is not too heavily loaded for the power used.

I would like, however, to make another suggestion for securing propulsion at greater speeds than at present exist. It is possible that this may be found by the use of machines with flapping wings. Only a very slow motion would be required for a large machine with a wide span. The method of flapping, or rather the means used for creating the movement of the wings, could be by an engine. Such a machine would most probably have to be catapulted into the air, as flapping would be very inefficient at low speeds. However, a machine of this kind could be made to land like an ordinary aeroplane ; in fact, it would probably be able to land at much lower speeds.

The aerial side of the postal service is certainly one branch that should extend and progress, assuming that civilization does not commit suicide. The extent of this progress must depend largely on the economic

situation which will prevail in future years. Money cannot be spent twice—on both armaments and progressive pursuits. It would appear that the more we spend on armaments the less we will have to spend in other ways, and as so often happens the axe of economy falls firstly on scientific research. This is a short-sighted policy which must be obvious to every intelligent person, but it is votes which usually count where national expenditure is concerned. War would probably curtail existing services, and there would be generally a retrograde effect on the air and postal services.

Actually we could continue to build the present large quantity of war material that we are doing, and yet enjoy a much higher standard of living, as there are millions of unemployed and also millions employed at unnecessary and inefficient occupations.

Since the early days of aviation it has been known that the resistance to forward progress is reduced considerably if flying is carried out at high altitudes. For example, it is very interesting to observe that it requires as much power to drive an aeroplane at 228 miles an hour at sea-level as it does at about 1000 miles an hour at an altitude of 12 miles above sea-level. Even to-day aeroplanes have been built which can fly at the tremendous speed of 400 to 500 miles an hour at sea-level.

The Germans, during the later stages of the War, astounded the world by firing shots into Paris from a distance of 75 miles by means of their gun known as 'Big Bertha.' This remarkable feat was made possible by the reduction of head resistance obtained by passing the shell through the rarefied air at a high altitude during a large portion of its journey.

With present-day super-charged engines maximum power is sometimes arranged to be attained at a height of 25,000 feet, and I see even with this mode of power,

wasteful though it may be, no reason why machines should not be capable of flying at very tremendous speeds. At an altitude of twelve miles there is the added advantage of winds which attain a velocity of 200 miles an hour. Then at this height a pilot would find a perfectly clear atmosphere, avoiding rain, snow, monsoons, and ice formations which have such a deterrent effect upon safety and speed.

Already machines are being built with apparatus which pumps warm air into the enclosed cabins, and keeps it at a pressure of about 10 lb. per square inch. The cabin being hermetically sealed the passengers do not feel the effects of the cold and rarefied atmosphere. This would also help to insulate them from the noise of the propellers and the engines, but not from wireless noise. The sunshine that came through the windows would be quite hot, yet outside the temperature would be many degrees below zero.

Actually if the speed of 700 miles an hour is reached, the noise of the outboard engines would be swept back or rather left behind before it even had a chance of reaching the passengers in the cabin. Travelling above the speed of sound may seem fantastic, but it may be by no means impossible.

Since the outside pressure—or rather lack of pressure—at an altitude of twelve miles is only three-quarters of a pound per square inch, there would naturally be an outward bursting stress in the cabin. This cabin would be designed to be of circular cross-section with domed ends, all forming a structural part of the fuselage or hull. This stress although great is slight in comparison with the usual stresses which have to be allowed for even in present-day design, so that there need be no fear of any increase in weight on that score. The glass windows would have to be small and numerous in order to reduce their thickness and weight.

The engine or engines for this type of high-speed flying craft would be super-charged. It has been found that the temperature at a height of eight to twelve miles above the earth remains constant—being about minus 54 degrees Centigrade. It is slightly less cold at this height above England than it is over the Equator. Aeroplanes of this type would be fitted with variable pitch propellers, the pitch being increased as the machine gains height and speed in the rarefied air.

It is because I realize the great importance of flying-boats that I now interest myself mainly in their manufacture. Flying-boats of 200 tons could be built and engined at the present time and they could carry, in comfort, over a hundred passengers over long distances. With developments in design of both machines and engines it is clear that within a few years we may see giant air-liners of many hundreds of tons crossing the oceans of the world. It is unlikely that land machines of this size would prove to be a practical proposition. The loads would be too heavy for any ordinary landing mechanism to take, especially in forced landings, whereas with flying-boats the waters of the sea are always the same.

Then again, if wind surface had to be cut down, the huge under-carriages that would be required for land machines would have to be made retractable, and the design difficulty in this connection is very great, for the landing chassis could hardly be left exposed during flight.

This brings me to the question of aerodromes. At the present time the sites for these are usually some distance from the centres of the cities they serve. This is a very serious defect for almost as much time is occupied in fairly short flights in getting to and from the aerodromes as is occupied by the actual flight itself. Such a position must tend to act as a deterrent o the full and proper use of air transportation.

This state of affairs will be overcome, and I have already made some suggestions on possible methods. Let me add to my prophesies. I see no reason why machines should not be launched into the air by some form of catapult which would obviate the need of long runaways. After all, one of the earliest machines made—that of the Wright Brothers—was launched in this manner. Such a catapulting machine can be directed in any direction desired to cope with wind conditions, and it should be feasible to get an aeroplane well into the air in the course of a hundred yards or so. The question of landing is not so easy, but failing the ideas I have already proposed I suggest that a method does exist by which in-coming aeroplanes would fly into a large net which would break their speed and enable them to sink to the ground. This method has already been tried out in experimental work where models have had tentacles which they open out just before coming in contact with the net, and thus protect the rest of the machine.

Whenever I look at an aerodrome I am distressed at the very large amount of space which is being wasted. If the land is valuable, then an absurd sum of money is locked up in having ground, most of which should not be required. Most aerodromes are square or oblong in shape, the idea being that there must be sufficient space for an aeroplane to land in any direction dictated by the wind at the moment of landing. I cannot believe that our inventors will not overcome this handicap.

Even if it is considered necessary for a machine to land against wind, and even if our types of machines are not altered to give some kind of helicopter action in landing, there is the alternative of their being provided with swivel under-carriages. By this means an aeroplane might well have its wings facing in a different angle to the under-carriage which would

then crab straight down one main central landing-strip which would be all that would be needed.

Acrodromes are among the most inefficient things in aviation, but their inefficiency is not due to those who actually control them, but to the designers of aeroplanes who ought soon to be able to make machines which will require entirely different types of landing-places.

Perhaps these ideas of mine may seem fantastic, but then most of the things which we now accept as being quite normal in our lives appeared fantastic—only a few years back. Picture a man coming to life once more who had died just before the War. He would indeed fail to realize what earth he had returned to.

I will only make brief mention of one more line of advance. I refer to the possible development of new materials in aeroplane construction. There is no reason why new non-corrosive light alloys should not be discovered. Such improvements would contribute greatly to the reduction of present-day structure weights, which in turn would give a greater load-carrying capacity to machines. At present a great deal of power and fuel is needed simply to get a machine into the air. Any saving in this direction would go direct into ability to fly longer ranges or carry more paying load.

Then there are the developments which will accrue from the utilization of reinforced plastic materials. Already this form of construction is being adopted, although little has been done on these lines in this country. But the great savings in cost and time of manufacture, besides the great advance in performance, make me believe that we shall soon see great developments on these lines.

But none of these suggestions are nearly so important as the more essential one of securing slower

and more efficient get-offs and landings. It is when these are solved that we will come much nearer to the idea of practical and universal flight.

If we do have machines of the type which I have portrayed, then I visualize flying speeds of 700 to 1000 miles an hour. The time will then come when it will be possible for a person to be in two places at the same time. For example, a passenger might leave London by high-altitude airway, say at 8 a.m., and would find on alighting at New York that the clocks there would be registering also 8 a.m. of the same day, for there is a five-hours' difference in time, and this would be the time taken to make the trans-Atlantic flight. There is no reason why London newspapers should not appear on the breakfast-table in New York the same day.

The trans-Empire aeroplanes would make long non-stop flights or jumps of from 3000 to 5000 miles. It has been proposed to have a chain of huge floating harbours and docks across wide oceans. Then there would be artificial lakes or reservoirs which would be constructed near inland towns and centres in order to enable the giant flying-boats to serve such places.

In another direction I can see great advance. When the buying power of the community keeps pace with production, civilization will undergo a great change for the better. Even unskilled workmen should be able to enjoy a high standard of living, taking occasional trips by air round the Empire.

From these views which I have expressed I feel sure that it will be realized that the young aviation engineer of to-day and to-morrow will have ample scope for the exercise of his brains and skill.

Meanwhile we live in times of wonderful ability, vast potentialities—and crass stupidity.

CHAPTER SEVENTEEN

FLYING ON

TIME Marches On. . . .

I now look back on more than thirty years spent in the 'World of Wings.' In every direction I see changes and advances which might well be termed 'miraculous.'

The methods of learning to fly to-day are radically different to what they were when I started my early flying experiments. Then one used to start from the ground and work upwards, a method which I still think has certain advantages over the modern way where the pupil is taken to a height of a thousand feet or so, and then is given instruction.

A few years back I took a 'refresher' course in flying which I found was very interesting. My instructor, at times, thought I would not be able to make a good landing, but I managed to do so without feeling worried. At the present time I like, when accompanying test pilots on our machines, to try the controls in order to see that they are well-balanced out and are easy to operate.

To-day the pupil learns to fly without thinking much of the possibility of having accidents, but in the early days such were almost an accompaniment of most flights.

There is, unfortunately, a considerable tendency in aircraft design to-day to make machines more and more complicated. I am totally opposed to this for I have always aimed myself at clean lines, the reduction

of all unnecessary parts and even the abolition of the tail, if it should be practical (which I believe will prove to be the case).

I think I have made it absolutely clear that if flying is to become popular in the way that motor cars are popular, then everything must be done to simplify machines. Some designers unfortunately often take the opposite view and aim at increasing complications instead of decreasing them.

The same idea has persisted in the teaching of pupils to fly. There are some who think that training should be done on the safest possible aeroplane so that pupils may become accustomed to the air and accustomed to finding their way about before flying anything dangerous. But there are others who favour training in aeroplanes which may not be dangerous in the hands of a skilled pilot, but are dangerous in the hands of a careless novice. Their argument being that with a dangerous or difficult machine the new pilot will learn respect for it and not take any liberties.

I do not agree with this latter theory for all aeroplanes should be as foolproof as possible. We have quite enough troubles in the air such as fog and collision, errors of navigation and so on, without adding to the pilot's difficulties by making him control his machine as though it were an acrobatic feat.

Not long ago a friend of mine commented on the fact that whereas in the pioneer days the embryo flier took part in many crashes, yet few of them proved to be fatal, to-day when an accident does take place there is a much greater chance of a serious and often fatal ending. He instanced my own case where I had a number of crashes, and yet apart from my Boston accident, I seldom had anything worse physically than minor cuts, bruises, and bent bones.

Undoubtedly increased speeds must result in greater dangers when there is an accident, although we must

bear in mind, whilst machines are getting faster and faster, improvements are being made in high lift wiring sections and air brakes which permit lower landing speeds. It is undoubtedly true that crashes have diminished in proportion to flying, although the results of such crashes have grown worse. Then, again, with the larger passenger machines which are now in use the outward appearance of one big crash is more spectacular than a far larger number of smaller accidents. We can notice this in other forms of life as, for instance, in road accidents where the total number of individual deaths on the roads now reaches enormous figures—and no one gets really excited. But let there be one big accident and the public gets almost hysterical in its demand for inquiries into the causes.

The United States Civil Aeronautics authorities have gone into the matter of crashing with that thoroughness which they bring to the work of statistics. In a recent report which deals only with regular air lines, they show that the upward trend of safety during the last ten years has become very marked.

In 1928, 23 people were killed in 325 accidents (11 fatal) in about 10½ million miles of flying. In 1937, 52 persons were killed in 386 accidents (5 fatal), but 77 million miles were flown. Thus the passenger miles per passenger killed had risen tremendously. This great increase in safety does have occasional set-backs as occurred in 1936 when 61 persons were killed in 380 accidents, (8 fatal) in 73½ million miles of flying.

It was not so many years back that air liners averaged about 110 miles per hour, so statistically a passenger was able to do about 200,000 hours of flying before being killed. Twenty-three years of non-stop flying is a long enough period to suggest safety to the average person.

The causes of all serious accidents are given in this American report and they are analysed minutely according to the evidence given in inquiries. Actually fatal accidents are not analysed separately, for the causes of an accident are much the same, whatever the actual result to the passengers may be.

For the whole ten years there were 38 per cent of all accidents caused by weather or bad terrain, airports, etc. The next largest percentage is 21 per cent for pilot error, 17 per cent for motor failure, 15 per cent for structural failure (usually under-carriages), 4 per cent personal errors other than the pilot, and 2 per cent for handling qualities. This last means vicious aeroplanes.

It is interesting to note that throughout the ten years for which these figures are given, the proportions annually remain very much the same and variations make little difference.

Even accidents caused by the weather have remained constant, which may seem, at first, strange in view of the amount of money which is being spent on providing equipment such as wireless, intended to obviate such climatic conditions, but it seems that what is gained by increasing such gadgets is lost by forcing pilots to fly faster and more heavily loaded machines which need bigger and better aerodromes on which to land. We seem, therefore, to be as far as ever from aeroplanes which can land slowly and will not crack up and burn up. Thus although the hours flown has increased by a far greater amount than the general public possibly realizes, yet the difference which might have been made by more efforts on the part of inventors and designers is still very considerable.

British aviation at the time of writing is expanding in all directions, even so our expansion will have to be very large if equal to the growth in Germany and Italy. When I sold out my interest in my old firm of A. V. Roe

& Co., Ltd., about ten years ago, the factory was capable of employing from 4000 to 5000 people. Since then the original works have been increased by a further five units, making six in all. Now there is a further extension which is costing £1,000,000. The new factory is actually the property of the Government who will lease it to the firm. This one new factory will enable the firm to employ another 5000 employees. The development of our aircraft industry seems to be stupendous, yet it would be a bold man who would suggest estimates of the size it may attain to.

When carrying out flying experiments in the early days one felt that the time was not far distant when the air would be used extensively in helping our transport system. Even to-day it is hardly realized what great steps have been made in the development of commercial flying since it really began to function seriously after the conclusion of the War. The following figures will, however, give some indication of its progress and advance. In 1919, the mileage flown by commercial air-lines is estimated to be 1,022,000; by 1931 this figure had risen to 83,500,000 miles; and the last official figures which have been issued for 1937 show that the mileage for that year was 198,868,000. Thus at the present time it is clear that there has been an increase of more than two hundred times over the figures which were accomplished only twenty years back.

Further figures emphasize the striking advances which have been made. During the five years, 1920–1924, commercial air-lines carried 10,100 passengers and 248 tons of freight. By 1930 the passengers carried in that single year had increased to 24,000, and there were also 832 tons of freight. Seven years later, in 1937, these figures had increased to 244,000 passengers and 3961 tons of freight. Since that date

these figures must also have been greatly augmented, especially when we consider that so much of our Empire mail is now carried by air.

Thirty years ago only one person, M. Blériot, had crossed the English Channel by air. In 1937 close on 24,000 passengers travelled on this route by this mode of transport. Such figures and comparisons seem astounding in retrospect, but we live in an age of excitement when the shattering of records is accepted without surprise and almost without comment.

The younger generation may sometimes wonder if further advances are possible, but I would assure them that it is difficult to arrive at finality in improving complicated mechanical, and one might add electrical, devices. Aeroplanes and motor cars are excellent to-day, but they will be continually improved for years to come. That being so it is difficult to foresee to what extent improvements will take place.

We are constantly being assured that the only way to make ourselves safe from air attack is to be strong in the air. As one whose money is chiefly invested in the aircraft industry I might be expected to uphold this contention. But when I consider that the other leading nations are saying the same sort of thing, I feel it is obvious that such claims to safety are flimsy.

One thing is certain, that the world being what it is, we must maintain a large Air Force. We never know who will be our next ally or enemy, and it is best that we endeavour as far as possible to rely upon ourselves along with the Dominions as far as strength is concerned. Then we need not fear the odd and panicky decisions of politicians.

I am rather dubious as to the real efficiency of some of the Continental air forces, especially some of those which we claim as allies. We are told about the size and power of the Soviet Air Force, yet it would seem

a real miracle if this nation which is so notoriously deficient in a machine sense should have more or less suddenly overcome those defects which would in time of war mean that most of their machines would be out of action.

The German Air Force is undoubtedly a most effective body, although some think that its power and capacity has been greatly exaggerated by their propagandists. One understands that its quality is high and the enthusiasm of its personnel considerable, but the Germans are supposed to take themselves very seriously. That is the great difference between the British and the Germans. Perhaps, however, the geographical position of the Germans, surrounded by enemies, forces a more serious outlook than our own, Still there is no doubt that to-day our own Air Force has as high a morale as any in the world.

Whilst I do not advocate slackening our efforts to be supreme in the air, yet I do feel that much more could be done to remove the causes of war. I have, however, dealt at length with this matter in my previous chapters dealing with currency reform, which I hope the reader will think are *worth all the other chapters put together*. I am just as determined a pioneer in this cause as I ever was in flying and in the other inventions I have made. In fact even more so. I see a less amount of hostility to currency reform than I did do a few years ago, and many admit there is something radically wrong ; I feel even a greater zest now than I used to experience whilst making my early flights at the thought that my present work may lead to the increased security and happiness of humanity.

I believe that in this work, as in other branches of development, the Englishman has a great part to play. In all fields of creative endeavour he will, if given a chance, take a lot of beating. When we hear, for instance, about mechanical devices or great engineering

achievements, or even successful business enterprises in America, it will often be found that an Englishman was responsible.

There can be few greater or more worth-while thrills than those obtained from the creation and the working out of ideas, especially when those ideas prove successful or they are also ideals.

Each step of advance as it is accomplished is a great thrill, and then there is the greater excitement and anticipation of the next step. My first flight was only a 'hop,' it is true, but it was a start. People doubted. Then came longer 'hops.' People still doubted. Then there came the time when I made my first turn in the air, and then came the first complete circular flight. The doubting continued. If I had not been convinced in my own mind about the real value of my work which I was doing, I might very well have retired into more established walks of life. There is an obvious lesson and moral to be gained from what I have just stated. It is that a sound idea if persisted in must, in time, come to fruition.

In the early days of flying, to take an aeroplane into the air could hardly be described as safe. The list of fatalities per thousand miles flown indicates this. It was not merely lack of skill in the pilots. Machines in those days were often structurally weak simply because we did not then have the knowledge which we possess to-day concerning stresses, strains, and correct designing. Then our engines were, likewise, subject to constant mechanical defects. These disadvantages have been largely remedied to-day with the result that it is very seldom one hears of accidents from these causes.

I have heard persons querying the value of record-breaking flights, but surely much of our advance has been due to the pioneer efforts made at improving on existing records. I would not undervalue the

psychological effects which result from our curiosity and our search for advance, but merely from the practical point of view the strains brought to bear on both machines and engines, and the effect of weather conditions, ice formations, etc., have all brought knowledge and consequently improvement.

It is not yet ten years back that a flight from the Cape to Cairo was considered an astounding feat. Yet to-day thousands of persons post their letters to be carried along this route, and never give a thought as to their possible non-arrival. The same adverse climatic conditions exist now as they did then, but our knowledge which we possess to-day enables us to keep aircraft informed in the air about these conditions. Our knowledge of every branch of flying has rapidly increased and along with the development of organization has enabled man to triumph over early difficulties.

Ten years is not a long period in life. Even thirty years is but a short span in our history, but when I compare the figures for this period I confess that present-day development, wonderful as it is, seems only natural. In 1909 there were no passenger air-lines, no mail services by air, but man had at last succeeded in flying. That was the great feat, and all other developments proceeded logically from this one fact. Progress has, since then, been marked by a succession of victories over the causes of accidents. It is these victories which those of us who have been connected with aviation from its earliest years most fully appreciate.

Major C. C. Turner, writing on this subject, gives views which I can thoroughly endorse.

> 'From time to time a new critic arises lacking historical knowledge and the historical sense, and, shocked by two or three accidents, he announces his "discovery" that flying is dangerous. Those

who have taken part in the progress of aviation, on the other hand, are impressed by the vanquishing of one danger after another, and are confident that the remaining problems will be solved.

'One thing that the ignorant critic omits to take into consideration is the rapid development in performance, which has not been accompanied by a corresponding advance in the casualty rate. On any basis of computation, such as the number of fatalities to flights made or distance flown, there is a steady diminution of sacrifice, and this, despite the fact that in speed, in climb, in duration, and in load of goods, munitions, or passengers carried, the capabilities of aeroplanes have steadily improved. Even in military flying, in which military risks are taken and intensive training is carried on, the casualty list is on the decline.'

Up to the end of 1909 there had been only sixty-four flights of more than an hour's duration. In the following year this number was increased to 397, and the fatal accidents amounted to 29. Progress then became rapid and in the first six months of 1911 there were 667 flights exceeding an hour, but the fatalities only numbered 35. These figures indicate that in 1910 each fatality represented flights of 3500 miles, whilst in 1911 this proportion had been bettered to an average death for about 5000 miles of flight. The figures of the present day can hardly be compared, for they run into seven figure distances for each fatality, thus it can be claimed that reasonable safety has been attained.

Yet it was just thirty years ago (1909) since I was nearly placed in the police-court for obstinate persistence in my flying experiments at Lea Marshes!

Then, on 8 June 1928, I was very proud to be the guest of honour at a banquet which was given me at the

Savoy Hotel by the Royal Aero Club, the Royal Aeronautical Society, the Society of British Aircraft Constructors, and the Aerial League of the British Empire. Lord Wakefield was in the chair and the Duke of York, now His Majesty the King, honoured me by attending the dance which followed.

I now come to the end of this book—my autobiography. I only hope my readers will forgive my various digressions from the subject of aviation, but I find it a great effort to think and write solely of my past when I would far sooner write entirely of the amazingly interesting future possibilities of our great country and Empire. It is the future—not the past—with its tremendous potentialities which fascinates and grips one. I feel about its developments a greater thrill than ever I had in the past. I think of the wonderful opportunity our Government has, if it would only exercise its prerogative over the creation and issue of the currency in a sound manner. When it does so it will automatically convert soul-destroying unemployment —the greatest scourge of our age—into soul-inspiring opportunities, for I am certain that if we are financially strong, which we can be, instead of hopelessly in debt, we shall be prosperous in our commerce. Then we can rest assured we will also be strong in the air. In fact we would be strong in every conceivable way. The higher standard of living that everybody would enjoy would be a small matter compared to the peace and security which is likely to prevail. Under our present system millions of people have no opportunity for developing their natural talents which might not only enrich themselves, but the world as well.

The first leading country that adopts a sound State Currency System will be quickly followed by the other nations. People will then say: "Why be such fools as to build huge quantities of war material simply to kill people and destroy their homes when we can

be building better homes and enjoying happier lives?"

Meanwhile, it is the writer's greatest ambition to introduce a sound State currency system into some country, preferably our own, for it would be difficult to render a greater service to humanity.

APPENDIX

Tabulated List of 'Avro' and 'Saro' Aeroplanes

'Roe I' Biplane

Built 1907–1908.

Length.—23 feet.
Span.—30 feet.
Weight.—200 lb. (empty). 350 lb. (with engine).
Motor.—24 h.p. 'Antoinette.'
Remarks.—This was my first machine to leave the ground.

'Bull's Eye' or 'Roe I' Triplane

Built 1909.

Maximum length.—23 feet.
Maximum breadth.—20 feet.
Supporting surface.—320 sq. feet.
Total weight.—200 lb. (without pilot).
Body.—Triangular section fusiform deal girder, covered with cotton-oiled paper backed by muslin. The motor was in the fore part and the pilot sat in a well about 4 feet abaft the main planes.
Wings.—The three superimposed main planes, each 20 feet by 3 feet 7 inches, were set at an angle of 5°. The three superimposed tail planes measured 10 feet by 3 feet 7 inches.
Motor.—10 h.p. 'J.A.P.'

Steering.—Vertical steering effected by altering the inclination of the main planes bodily, the tail remaining stationary. Horizontal steering effected by means of a rudder abaft the tail, and by twisting the rear edges of the main planes at the same time. All these movements were controlled by a single lever which was pushed forward or pulled back for descending or rising, and moved from and to either side for turning.

Remarks.—A vertical plane was fitted on each side, both between the main planes and between the tail planes. The motor being air cooled, channels were cut in the front of the body to concentrate the air on the motor. The outer 6 feet of main planes were made to fold back for housing or transport. The name 'Bull's Eye' was after the designation of my brother's braces.

'Roe II' Triplane

Built 1909.

Maximum length.—32 feet.

Supporting surface.—620 sq. feet.

Total weight.—650 lb. (without pilot).

Wings.—Planes were 32 feet by 5 feet 4 inches, otherwise as 'Roe I.'

Motor.—35 h.p. 8-cylinder 'J.A.P.'

Steering.—As in 'Roe I.'

Remarks.—This machine was simply a larger replica of 'Roe I.'

'Roe II' Triplane

Built 1909

Maximum length.—23 feet.

Maximum breadth.—20 feet.

Supporting surface.—320 sq. feet.

Total weight.—500 lb. (without pilot).
Body.—Triangular. Driver's seat amidships.
Planes.—Maximum span, 20 feet. Chord, 3 feet 6 inches. Tail planes, each 10 feet by 3 feet 6 inches.
Motor.—(1) 9, and then 20 h.p. 'J.A.P.' (2) 35 h.p. 'J.A.P.'
Tractor.—One 4-bladed to (1), 'Avro' to (2).
Steering.—Elevator. Main planes warped. Control, to and from lever. Rudder behind tail. Control, side motion of lever.
Remarks.—Special features: Warping main planes. Lifting tail.
No. (1) machine was sold to Rangie Cycle Co.
No. (2) was my own experimental.

'Roe III' Triplane

Completed August 1st, 1910.

Maximum length.—23 feet.
Maximum breadth.—31 feet.
Total supporting surface.—362 feet.
Total weight.—750 lb. (including pilot).
Body.—Triangular, 20 by 2 by 2 feet.
Planes.—Maximum span, 2 upper planes, 31 feet. Bottom plane, 20 feet.
Motor.—35 h.p. 'J.A.P.' or 'Green.'
Tractor.—1 'Avro.'
Steering.—Tail elevator. Rudder on tail. Ailerons to middle plane.
Special features.—Fixed planes and ailerons substituted for 'Roe II' type. Lifting tail.
Remarks.—Six machines of this type were built of which two were burned *en route* to Blackpool, three sold, and one retained.

'Roe IV' Triplane

Completed September, 1910.

Maximum length.—22 feet 6 inches.

Maximum breadth.—31 feet.

Supporting surface.—287 sq. feet.

Total weight.—350 lb. (without engine or pilot).

Planes.—Maximum span, upper planes 31 feet; bottom plane, 20 feet. Tail, non-lifting type.

Motor.—40 h.p. 'Gnome.'

Propellor.—One 'Avro' tractor.

Steering.—Two elevators behind tail. Rudder in rear. Ailerons to middle plane.

Special features.—Mono tail. First departure from the lifting-tail type.

In 1911 I abandoned triplanes for 'Avro' biplanes, and also completed a monoplane (totally enclosed) in April, 1912. There was also in the same year a military biplane with limousine type body.

Model.	D. 1911–12 2-seater biplane.	E. 1912 2-seater biplane.	F. 1912 totally enclosed biplane.	G. 1912–13 totally enclosed biplane.	E. 1912–13 hydro-biplane.
Length . feet	31	29	23	29	33
Span . . feet	31	36	28	36	47
Area . sq. feet	279	335	158	335	478
Weight—					
empty . lb.	800	900	550	1191	1740
fully loaded lb.	—	1300	800	1700	2700
Motor . h.p.	35	50 'Gnome'	40 'Viale'	60 'Green'	100 'Gnome'
Speed m.p.h.	48	61	65	62	55

Remarks.—Of the E. 1912 type four machines were purchased by the Royal Flying Corps and one by the Portuguese Government. Climbing speed of this type, 440 feet per minute.

The hydro-biplane was sold to the Royal Flying Corps (Naval Wing) in 1913.

In 1913 the 'Avro 504' first made its appearance and a number of other types of biplanes were produced.

Model.		Land machine '500' 1911 modified.	Land machine '504.'	Land machine '508.'	Land machine '511.'	Seaplane '504.'	Seaplane '509.'	Seaplane '510.
Length	feet	29	$29\frac{1}{4}$	$26\frac{3}{4}$	22	$29\frac{1}{2}$	44	$37\frac{1}{2}$
Span	feet	36	36	44	26	36	80	63
							56	38
							931	564
Area	sq. feet	335	242	470	235	342		
Weight—							2800	2005
(empty)	lb.	900	924	1000	675	1079	4510	3125
(fully loaded)	lb.	1300	1574	1680	950	1719	2–120	160
Motor	h.p.	50	80	100	80	80	'Aust.-Daimler'	'Gnome'
		'Gnome'	'Gnome'	'Gnome'	'Gnome'	'Gnome'		
Speed—								80
Max. m.p.h.		65	82	70	100	75	70	35
Min. m.p.h.		30	35	35	35	40	35	

Remarks.—Type '504.' 2-seater tractor biplane. Easily dismounted. Also constructed as seaplane.
Type '508.' 2-seater propeller biplane with monoplane tail. Suitable for gun-carrying and reconnaissance work. Weight includes gun.
Type '509.' Fuselage seaplane with twin-propellers and engines, these being mounted on planes at either side of fuselage. A fighting machine with gun and wireless installation, and capable of seating 2–4 persons.
Type '510.' 2-seater tractor seaplane. Carried wireless. Folding planes. With gun.
Type '511.' Light single-seater tractor biplane. Easily dismantled and designed for scouting purposes.

During the War the '504' was constantly being modified until it ended in being model '504 K'—the standard training machine for the Royal Air Force.

Model.	'504 K' biplane.	'504 L' seaplane.	'530' 2-seater fighter.	'Manchester' Mark I twin-engined biplane.	'Manchester' Mark II twin-engined biplane.	'Avro Spider.'	'Avro Baby.'
Type & purpose .	2-seater training	The same as '504 K' but fitted with two pontoon floats	2-seater fighter	3-seater reconnaissance and bombing	same as Mark I	single-seater fighter	single-seater sporting
Span . . feet	36	—	36	60	60	$28\frac{1}{2}$ $21\frac{1}{2}$	25
Length . feet	$29\frac{1}{2}$	—	$28\frac{1}{2}$	37	37	$20\frac{1}{2}$	17
Weight—							
(empty) . lb.	1231	—	1695	4049	4574	1148	625
(loaded) . lb.	1829	—	2680	6586	7158	1734	857
Motor . h.p.	100 'Gnome' 110 'Clerget' 110 'Le Rhone' 130 'Clerget'	130 'Clerget' 175 'A.B.C.'	200 'Sunbeam' 200 'Hispano-Suiza'	320 'A.B.C.'	300 'Siddeley'	180 'B.R.'	35 'Green'
Speed—							
Max. m.p.h. .	95	90	114	128	125	124	80
Min. m.p.h. .	45	45	58	45	45	45	32

Remarks.—Type '530' was never put into production.

The two 'Manchester' types had a common origin in the 'Avro Pike' a twin-engined, 3-seater fighter-bomber designed for the R.N.A.S. in 1916.

The first 'Avro Baby' had the same 'Green' engine I used in 1912.

Model.		Biplane '504 A'	Seaplane '510.'	'529.'
Length . . .	feet	29½	38	—
Span . . .	feet	36	63	—
			38	
Weight, empty	lb.	1050	2050	—
Fully loaded	lb.	1700	2800	—
Motor . .	h.p.	80	150	2/230
		'Le Rhone'	'Sunbeam'	
Speed .	max. m.p.h.	86	70	106
	min. m.p.h.	43	50	—

Remarks.—The climb of the '504 A' was 3000 feet in 6 minutes. The '510' climbed 3000 feet in 15 minutes. '529' was a twin-engined bomber.

Model.	'Avro' Limousine biplane.	Renault 'Avro.'	'538.'	'547' triplane.	'Puma' seaplane.
					Built for
Type & purpose .	enclosed passenger carrier	3-seater joy-riding	single seater racing	5-seater commercial	1919 Schneider Cup Trials
Span . . feet	37	36	28	37	25½
Length . feet	29	29	20½	30	21
Weight—					
(empty) lb.	1431	1338	975	2077	—
(loaded) lb.	—	1943	1400	3200	—
Motor . h.p.	150 'B.R.'	80 'Renault'	150 Bentley 'Rotary'	200 'Beardmore'	240 'Siddeley Puma'
Speed—					
Max. m.p.h. .	90	80	125	85	—
Min. m.p.h. .	40	40	46	52	—

Remarks.—The 'Avro' Limousine was a modified '504' standard training machine. The '547' was built almost entirely of fittings of '504' of which huge stocks existed at the end of the War.

Remarks.—Type '530' was never put into production. The two 'Manchester' types had a common origin in the 'Avro Pike' a twin-engined, 3-seater fighter-bomber designed for the R.N.A.S. in 1916. The first 'Avro Baby' had the same 'Green' engine I used in 1912.

Model.	'Avro Baby 543.'	Antarctic Baby Seaplane.	'Avro Viper.'	Aerial Derby Racer.
Type & purpose	2-seater	2-seater	Modified '504'	Modification of Schneider Cup Seaplane
Span . . feet	25 23	26	—	—
Length . feet	20	$22\frac{1}{2}$	—	—
Weight—				
(empty) . lb.	630	1000	—	—
(loaded) . lb.	970	1600	—	—
Motor . h.p.	35 'Green'	80 'Le Rhone'	180 'Wolseley Viper'	450 'Napier'
Speed—				
Max. m.p.h.	82	90	—	—
Min. m.p.h.	40	43	—	—

Remarks.—The Antarctic Baby Seaplane was built for the Shackleton-Rowett Expedition. The Aerial Derby racer crashed on her trials.

Model.	'Aldershot.'	'Napier.'	'Bison.'	'Aldershot-'Cub.'
		Modified 'Aldershot'	Seaplane reconnaissance	Modified 'Aldershot'
Type . .	Bomber	—	46	—
Span . .	68	—	37	—
Length feet	45	—	—	—
Weight—				
(empty) lb.	—	—	5800	—
(loaded) lb.	10,950	—	450	1000
Motor h.p.	650 'Rolls-Royce Condor'	1000 'Napier'	'Napier Lion'	'Napier Cub'
Speed—				
Max. m.p.h.	110	—	110	—
Min. m.p.h.	50	—	50	—

Model.		'504 N.'	'558.'	'560.'
Type & purpose		Modification '504'	Single-seater Light	Single-seater Light
Span .	feet	—	30	36
Length .	feet	—	20	21
Weight—				
(empty)	lb.	—	294	285
(loaded)	lb.	—	480	471
Motor .	h.p.	160 'Armstrong Siddeley Lynx'	500 c.c. 'Douglas'	698 c.c. 'Blackburne'
Speed—				
Max. m.p.h. .		—	—	—
Min. m.p.h. .		—	—	—

Model.		'504 K' Mark II.	'Andover.'	12-seater '563.'	'Avis.'
Type . .		modified '504'	bomber similar to 'Aldershot' in many respects	commercial	2-seater light
Span .	feet	—	68	68	30
Length .	feet	—	51	51½	24
Weight—					
(empty)	lb.	—	6991	6800	582
(loaded)	lb.	—	11,500	10,685	950
Motor .	h.p.	—	650 'Rolls Royce Condor'	650 'Rolls Royce Condor'	1096 c.c. 'Bristol Cherub'
Speed—					
Max. m.p.h. .		—	110	110	75
Min. m.p.h. .		—	50	50	30

Model.	'504 R' Gosport.	'Lynx' seaplane.	'Lucifer.' '504 N' but fitted with 'Lucifer' engine	'Ava.'	'Avenger.'	'Avian II.'
Type . .	modified '504'	'504 N' built as seaplane		bomber	single-seater fighter	private owner
Span . feet	—	—	—	—	28	28
Length feet	—	—	—	—	25½	24
Weight—						
(empty) lb.	—	—	—	—	2368	907
(loaded) lb.	1690	—	—	—	3414	1460
Motor . h.p.	100 'Mono'	—	—	two 650 'Rolls-Royce Condor'	570 'Napier Lion'	32/80 'Cirrus' Mark II
Speed—						
Max. m.p.h.	87	—	—	—	180	98
Min. m.p.h.	—	—	—	—	—	40

Model.	'Buffalo.'	'Buffalo' seaplane.
Type . .	2-seater reconnaissance-bomber, torpedo carrier	Same as 'Buffalo' land-plane but fitted with floats
Span . . feet	46	—
Length . . feet	37	—
Weight (empty) lb.	4233	—
(loaded) lb.	7420	—
Motor . . h.p.	550 'Napier Lion'	—
Speed max m.p.h.	135	—
min. m.p.h.	62	—

Model.		'Avro Five.'	'Avro Ten.'	'Antelope.'	'Mongoose.'	Military Training.
Type .		3-engined 4 passenger cabin monoplane	British-built version of Fokker 'F-VII'	2-seater military biplane	similar to '504 N'	training
Span .	feet	47	—	36	—	34
Length .	feet	36	—	32 31	—	26
Weight—						
(empty)	lb.	2790	—	2687	—	—
(loaded)	lb.	4420	—	4539	—	—
Motor .	h.p.	3/105	—	538	150	150
		'Armstrong-Siddeley' 'Genet Major'	—	'Rolls-Royce'	'Armstrong-Siddeley'	'Armstrong-Siddeley'
Speed—						
Max. m.p.h.		121	—	170	—	—
Min. m.p.h.		—	—	63	—	—

The following machines are the products of Saunders-Roe, Ltd. They are all amphibian flying-boats.

Model.		'Saro Cutty Sark.'	'Saro Windhover.'	'Saro Cloud.'
Type . . .		4 seater	6 seater	8–10 seater
Span . .	feet	45	54	64
Length . .	feet	34·5	41	50
Weight	(empty) lb.	2863	3790	6250
	(loaded) lb.	3700	5350	9500
Motor . .	h.p.	2/100	3/105	2/300
		'Cirrus Hermes'	'D.H. Gypsy II'	'Wright Whirlwind Armstrong-Siddeley'
Speed	max. m.p.h.	105	110	118
	min. m.p.h.	46	53	55

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